CONNECTICUT AGR[illegible] of Connecticut

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Forty-first Annual Report

OF

The Connecticut Agricultural Experiment Station

Being the annual report for the year ended October 31

1917

and including Bulletins Nos. 196 to 206

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NEW HAVEN
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1918

PUBLICATION
APPROVED BY
THE BOARD OF CONTROL

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF.

SEPTEMBER 30, 1917.

BOARD OF CONTROL.

His Excellency, Marcus H. Holcomb, *ex-officio, President.*
*H. W. Conn, *Vice-President*....Middletown
George A. Hopson, *Secretary*....Wallingford
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Analytical Laboratory.	JOHN PHILLIPS STREET, M.S., *Chemist in Charge.* E. MONROE BAILEY, PH.D., C. B. MORISON, B.S., C. E. SHEPARD, } *Assistants.* †W. L. ADAMS, B.S., ‡M. D'ESOPO, PH.B. HUGO LANGE, *Laboratory Helper.* V. L. CHURCHILL, *Sampling Agent.*
Protein Research.	T. B. OSBORNE, PH.D., D.SC., *Chemist in Charge.* MISS E. L. FERRY, M.S., *Assistant.*
Botany.	G. P. CLINTON, SC.D., *Botanist.* E. M. STODDARD, B.S., *Assistant Botanist.* §MISS F. A. MCCORMICK, PH.D., *Scientific Assistant.* G. E. GRAHAM, *General Assistant.*
Entomology.	W. E. BRITTON, PH.D., *Entomologist; State Entomologist.* B. H. WALDEN, B.AGR., *First Assistant.* Q. S. LOWRY, B.SC., I. W. DAVIS, B.SC., } *Assistants.* M. P. ZAPPE, B.S., MISS G. A. FOOTE, B.A., *Stenographer.*
Forestry.	WALTER O. FILLEY, *Forester; also State Forester and State Forest Fire Warden.* A. E. MOSS, M.F., *Assistant State and Station Forester.* MISS E. L. AVERY, *Stenographer.*
Plant Breeding.	DONALD F. JONES, M.S., *Plant Breeder.* C. D. HUBBELL, *Assistant.*
Vegetable Growing.	¶HOWARD F. HUBER.

* Died April 18, 1917. † Appointed May 1. ‡ Appointed April 19.
§ Appointed May 28. ¶ Resigned March 1.

TABLE OF CONTENTS.

Officers and Staff	iii
Contents	iv
Report of Board of Control	v
Report of Treasurer	xiv
Some Essential Facts regarding Nutrition	1
The Cereal Breakfast Foods	17
Domestic Supplies of Potash	45
Spray Calendar	53
Report on Food and Drug Products	99
Food Oils and Fats	199
An Experience in Keeping Poultry in the City	215
Report of Entomologist	227
Report on Commercial Fertilizers for 1917	371
Bee Keeping in Connecticut	423
Report on Commercial Feeding Stuffs	447
Index	479

CORRECTION.

It is stated on page 167 of Bulletin 200 (being the Food and Drug Report of this Station for 1917), that the Calomel Tablets numbered 11609 were *made by the Tailby-Nason Company.*

This statement is incorrect and was based on misinformation given to this Station. The name of the manufacturer cannot be ascertained, but the aforesaid company is not responsible for them.

E. H. JENKINS, Director.

Report of the Board of Control

OF

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

To His Excellency, Marcus H. Holcomb, Governor of Connecticut:

As required by law, the Board of Control of The Connecticut Agricultural Experiment Station herewith respectfully presents its annual report for the year ended October 31, 1917.

The following minute, adopted by the Board, records the death of one of its members:

Professor H. W. Conn, for ten years a member and the vice-president of the Board of Control of this Station, died at his home in Middletown, Connecticut, April 18, 1917.

Professor Conn was the professor of biology in Wesleyan University and the director of the State Board of Health Laboratory, which he organized in 1905 and of which he continued to be the director until the time of his death.

Perhaps his highest public service was rendered by his studies on milk and its various preparations, from the standpoint of the sanitarian and the humanitarian. He was especially interested in all means of protecting infant life by reasonable control of the milk supply, and gave time and talents without reserve to the work. In 1911 he was appointed by the New York Milk Committee as a member of the National Commission on Milk Standards and retained that position as long as he lived.

The members of this Board desire to place on its records their appreciation of Dr. Conn's faithful and efficient service as a member of their organization, and their recognition of the wider public service which he rendered to the State and to the whole country as a specialist whose interests were not bounded by his laboratory but embraced the every-day needs of the whole community, with a special regard to the most needy and helpless portion of it.

LEGISLATION AFFECTING THE STATION.

The General Assembly, at its last session, increased the biennial appropriation to the Station for current expenses by $2500 and to the State Entomologist by $4000.

It also appropriated $40,000 for the suppression of the gipsy and brown-tail moths and for inspection of imported nursery stock, $15,000 for the control of the white-pine blister rust, $5,000 for the purchase of land for State forests, and $9,000 for the Forest Fire Warden service.

A special appropriation of $28,000 was also made to the Station for the building of a heating plant.

The General Assembly also added considerably to the duties of the Station by the following Acts:

Chapter 23 provides that the Director shall have charge of all matters pertaining to the official control of insects or diseases which are, or threaten to be, serious pests, and gives him power, with approval of the governor, to make rules for the destruction of infested stock and to prohibit or regulate transportation of plants which may carry dangerous pests. He may also establish quarantines against other States or section of this State, after giving a public hearing on the matter.

Chapter 262 authorizes the Director to investigate and control the white-pine blister rust or currant rust and to destroy all pines, gooseberries, or currants infected with the disease. He may designate districts within which all wild species which are liable to infection may be destroyed.

Chapter 402 amends Chapter 264 of the Acts of 1915 and places the work of drainage of marshes for mosquito elimination in charge of the Director, wherever the State is to bear a share of the expense. It provides for due notice in advance to property owners whose land is to be ditched, for hearings in case of grievance, for assessment of benefits and damages, etc. It further provides that the Director shall maintain and keep in repair ditches, tide-gates, etc., which have been constructed hitherto with his approval, the State paying one-fourth and the town or borough three-fourths of this expense.

A special law also required the Director to assess damages resulting from the ditching of marsh land with each of eight citizens of Branford who made a claim to the Assembly for

damages. In case of disagreement, an arbitrator was to be appointed and the decision of two of the three was to be final. One-half of any assessed damage was to be paid by the State and one-half by the town of Branford.

The work on the suppression of the gipsy and brown-tail moths, on the inspection of imported nursery stock, and on the control of the white-pine blister rust will be reported by those members of the staff to whom the work was assigned, when the entire work of the calendar year is completed.

The Act providing for a heating plant did not make the appropriation available until October 1, 1917, which exposed us to the danger of being obliged to close the institution at any time during the winter when our worn-out heater might give out completely. Arrangement was finally made by which we were able to begin construction on July 8th. Various delays in the work will make it impossible to provide heat until the latter part of November. This results in much discomfort and a large expense for heating with gas, but we hope with no other material loss.

The new building is a one-story structure of brick and concrete, provided with a coal capacity of 180 tons and an 88 horse-power tubular boiler which supplies heat to all the Station buildings, the condensed water returning by gravity.

Under the powers granted by Chapter 23, it has not yet been necessary for the Director to order destruction of stock or establish quarantines of any kind.

Under the provisions of Chapter 262, the Director appointed Dr. Britton to have charge of the fall inspection of pines and *ribes* in all nurseries and to help, as far as possible, in the spring inspection; Dr. Clinton to have entire charge of all botanical studies relating to the nature and spread of the pine blister rust, and Mr. Stoddard to work under his direction on botanical studies; Mr. Filley to have charge of the work of scouting and destroying the blister rust and to employ the necessary laborers, with the assistance of Mr. Moss. Mr. Filley also kept the accounts of all expenses incurred in the work.

Under the requirements of Chapter 402, the director had to supervise during the summer both the ditching and other work of mosquito elimination on 600 acres of salt marsh, and the clearing and maintenance of ditches and culverts on 4108 acres of marsh previously drained.

As authorized by law, Mr. B. H. Walden was appointed the director's deputy to take immediate charge of the work. The law was not effective until May 16, 1917, by which time much of the spring clearing should have been done. It was extremely difficult to get labor of any kind to do the necessary work and almost impossible to get efficient labor. There was also much delay and added difficulty with labor because the work cannot be carried on steadily to a conclusion but has to be suspended during certain perigee tides.

Under such conditions work was greatly delayed and much not wholly unreasonable irritation developed among marsh-owners, because of the trampling of marsh grass by the workers, which would have been avoided if the work could have been seasonably finished.

Finally, the special Act above referred to made necessary an examination of eight different tracts of land in company with their owners, and considerable correspondence and conference. This having proved ineffective, an arbitrator was agreed upon at the last moment, all the tracts were again examined, damages were fixed by the agreement of the arbitrator and the owner of the land, and within the prescribed time the findings were filed by the Director with the Superior Court.

The Commission of Public Health, acting for the Board of Health Council, finding it desirable to locate in New Haven the Bureau of Laboratories of the Council, and having asked whether it would be possible for the Station to provide adequate quarters, this board arranged to give the Council, for a nominal rental, the use of the first floor and basement of what was formerly the botanical laboratory building. The Bureau of Laboratories took possession on September first. The arrangement is proving to be mutually satisfactory.

As the work of the different departments, so far as ready for publication, will be described in the forthcoming bulletins, we give here only a brief summary of the work of each.

Botany.

Dr. Clinton in Charge.

The principal projects have been: Studies of the effects of various fungicides on fungous diseases, and their injurious action, if any, on peaches and apples; the effect of different

fertilizers on the health, longevity and production of peach trees; a study of the nature and methods of spread of peach yellows; control of black rust of cherry; selection and spraying experiments with muskmelons; effects of different fertilizers on the diseases of certain vegetables; special studies of downy mildew and certain heteroeceous rusts.

Special studies of the white-pine blister rust have occupied much of the time of this department.

Studies of the causes and prevention of the partial failure of tobacco crops on certain areas in tobacco plantations have been continued.

This department has also co-operated with the County Farm Bureau in demonstrations of potato spraying.

Chemistry.

Mr. Street in Charge.

The work required by Statute has involved examination of 595 fertilizers, 259 feeds, 675 farm products, 1350 foods and drugs, and 1412 pieces of Babcock glassware. Expert evidence in court has been required in 7 cases. Some co-operative work has been done on analytical methods.

The chemist in charge has also been called upon for much public service, because of his experience in matters relating to food control. Thus, he is serving as a member of the National Committee to establish food definitions and standards, of the Committee on Revision of Analytical Methods of the American Association of Official Agricultural Chemists, as chairman of the Committee of the American Public Health Association on Nostrums, and as expert of the American Medical Association on diabetic foods. During the year he has prepared a book on The Composition of Certain Patent and Proprietary Medicines, published by the American Medical Association.

Entomology.

Dr. Britton in Charge.

The inspections required examination of 84 nurseries covering 1461 acres of land planted to nursery stock, 682 cases of imported stock, and 473 apiaries containing 4506 colonies.

The work on suppression of the gipsy moth has been actively carried on through the year. 6182 egg masses have been found and destroyed, more than 17,000 trees banded, 37,800 larvae found and destroyed, and 91 of the worst infestations sprayed with lead arsenate.

The mosquito control work, to which reference has been made, was in immediate charge of Dr. Britton's assistant, Mr. Walden.

A study of the very destructive European pine sawfly has been made and the results have been prepared for publication. Means have been devised for destroying a subtropical cockroach which was ruining roses and Easter lilies in one of the large greenhouses of the State. Various studies of other insects of economic importance are being made.

The Hymenoptera of Connecticut (Bulletin 22 of the Connecticut State Geological and Natural History Survey), a volume of 824 pages, 15 text figures and 10 plates, prepared by a number of contributors, under the direction of Dr. Britton, has been issued.

A check list of Connecticut Insects has been prepared by Dr. Britton and awaits publication.

Considerable progress has been made also on the Hemiptera of Connecticut, under Dr. Britton's direction. Even where written by other authors, these publications involve much work by the staff in preparing plates, indexing, proof-reading and typing.

Forestry.

Mr. Filley in Charge.

From the Mount Carmel grounds about 43,500 pine transplants have been supplied to the State forests.

About 52,000 two- and three-year old transplants are ready or setting next spring.

Observations have been begun on the pine stands of A. D. Bridge ons Co., of Hazardville, to determine if possible the cause of ie increasing weakness of mature trees, shown in loss of needles id ultimate death of the trees.

The work on the white-pine blister rust required the attention the Forester for most of the spring and summer. During May

and June eight men scouted sixty-eight pine plantations, covering 1100 acres. During July and August seven men scouted the State for infected *ribes*, in an endeavor to find by this means infected pines. As a result, eighteen pine infections were discovered.

In 35 towns, most of them east of the Connecticut River, *ribes* infections were found, but no serious pine infection, except at Pomfret.

In the region about Norfolk the native pine is most seriously threatened. Here, in the last two years, the gangs of men employed by Mr. Filley have endeavored to destroy all *ribes* on an area of 4300 acres. In addition, 600 acres were scouted for infection on pine. This is more expensive and probably less effective than work on *ribes*.

It is clear that on such badly infected areas a large proportion of the work of eradication must be done by private owners, with such co-operation as the State can supply.

A bulletin on the blister rust has been prepared, but, owing to difficulty in getting it approved by the Bureau of Plant Industry, under the co-operative agreement, its publication is postponed.

Plant Breeding.

Mr. Jones in Charge.

The investigations on the laws of inheritance in maize and tobacco, which have been carried on for years and which have contributed much of value to our knowledge of these laws, are still continued, being supported by the Federal grant made exclusively for research work.

The production of improved varieties of tobacco, by the crossing of good varieties and continued selection from their offspring, has now fixed several selections which are to be finally tested as to their merits by growing them on a considerable scale.

Of more immediate practical interest are the co-operative tests of the most promising corn varieties, made at Storrs and at Mount Carmel. These have now yielded results which justify recommendations to farmers, regarding choice of varieties for planting in 1918 and regarding sources of seed.

PROTEIN RESEARCH.

Dr. Osborne in Charge.

The Station's support of this work comes from the Federal research fund, known as the Adams Fund, but because of the value of the work, the Carnegie institution has for years contributed generously to its support.

The scope and results of this investigation cannot here be adequately set forth. It is enough to say that it is a fundamental study of nutrition, specially in relation to the efficiency of the protein components of food. The results are being published in technical journals, and it is intended shortly to issue a bulletin giving a popular account of some of the facts regarding feeding which these investigations have established.

Some further idea of the Station's work may be gathered from the following statistics:

Number of letters written	9,898
Public addresses	79
Papers in scientific journals	15
Papers in other journals	15
Specimens of insects and fungi identified for inquirers	485
Specimens added to herbarium	656
Samples of seed tested	112

The annual field meeting was held, as usual, at the Mount Carmel farm, on August 21, 1917, and brought together between four hundred and five hundred people. This experiment field which is used by all departments, has proved to be of very great service and is efficiently managed by Mr. Hubbell.

CHANGES IN THE STATION STAFF.

Mr. H. F. Huber, the vegetable expert, resigned on March 1, 1917, to take a position in New Jersey. Mr. W. C. Pelton has been appointed in his place and will shortly enter on his work here.

Miss Florence McCormick was appointed as botanical assistant, to be principally employed in studies of the pine blister rust, and began her work here in May, 1917.

Mr. Waldo L. Adams was engaged as assistant chemist on May 1, 1917.

Mr. M. D'Esopo was engaged as assistant chemist on April 19, 1917.

Publications.

During the time covered by this report the Station has issued four bulletins of the regular series and one bulletin of immediate information, aggregating 62 pages, with 26 figures and plates, and the annual report of 472 pages, with 20 plates.

All of which is respectfully submitted.

George A. Hopson,
Secretary.

New Haven, Conn., Oct. 31, 1917.

REPORT OF THE TREASURER, 1917.

E. H. JENKINS, in account with THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION for the fiscal year ended September 30, 1917.

RECEIPTS.

Balance on hand, October 1, 1916 (Analysis Fees)		$199.27
State Appropriation (Agriculture)	$17,500.00	
State Appropriation (Food)	2,500.00	
State Appropriation (Insect Pest)	4,000.00	
United States Appropriation (Hatch)	7,500.00	
United States Appropriation (Adams)	7,500.00	
Analysis Fees	9,197.25	
Sale of Automobile to State Forester	125.00	
Connecticut Agricultural College	600.00	
Miscellaneous Receipts	163.81	
Lockwood Trust Income (including sale of wood and Mt. Carmel Farm produce, $1,710.05)	10,910.05	
		$59,996.11
		$60,195.38

DISBURSEMENTS.

E. H. Jenkins, director,	salary	$2,800.00
E. H. Jenkins, treasurer,	"	400.00
V. E. Cole,	salary	1,018.51
L. M. Brautlecht	"	613.50
J. P. Street,	"	2,600.00
T. B. Osborne,	"	2,400.00
E. M. Bailey,	"	1,845.00
C. B. Morison,	"	1,435.00
C. E. Shepard,	"	1,127.50
W. E. Britton,	"	2,600.00
G. P. Clinton,	"	2,600.00
E. M. Stoddard,	"	1,487.50
W. O. Filley,	"	2,400.00
A. E. Moss,	"	1,825.00
E. L. Ferry,	"	1,320.00
H. F. Huber,	"	625.00
D. F. Jones,	"	1,537.50
W. L. Adams,	"	541.67
Michael D'Esopo,	"	402.78
B. H. Walden,	"	125.00
A. J. Wakeman,	"	208.33
C. S. Leavenworth,	"	116.66
Florence McCormick,	"	409.88

Hugo Lange, salary	$971.25
V. L. Churchill, "	997.50
William Veitch, "	735.00
Etta L Avery, "	504.00
C. D. Hubbell, "	840.00
G. E. Graham, "	892.50
L. S. Nolan, "	90.00
Mrs. L. D. Kelsey	441.00
Henry Kiley	819.00
Frank Sheldon	819.00
O. J. Welch	819.00
T. F. Barrows	478.50
Joseph Leschke	425.00
Labor	3,990.82
Publications	1,157.39
Postage	278.25
Stationery	410.88
Telephone and Telegraph	182.45
Freight and Express	165.90
Gas, Electricity and Kerosene	894.18
Coal	410.90
Water	120.20
Chemicals and Laboratory Supplies	1,154.85
Agricultural and Horticultural Supplies	150.81
Miscellaneous Supplies	741.02
Fertilizers	950.85
Feeding Stuffs	413.01
Library and Periodicals	559.86
Tools, Machinery and Appliances	1,146.97
Furniture and Fixtures	399.22
Scientific Apparatus	332.41
Live Stock	2.50
Traveling by the Board	284.39
Traveling by the Staff	1,000.77
Gasoline for Automobiles	321.41
Traveling in connection with Adams Fund Investigations	125.67
Insurance	638.78
Insect Pest Appropriation to State Entomologist	4,000.00
Contingent	254.99
New Buildings	23.73
Betterments	150.66
Repairs	207.82

Total Disbursements		$59,741.27
Balance on hand, Sept. 30, 1917 (Analysis Fees)		454.11
		$60,195.38

NEW HAVEN, CONN., Oct. 24, 1917.

THIS IS TO CERTIFY that we have audited the accounts of Mr. E. H. Jenkins, Treasurer of The Connecticut Agricultural Experiment Station, for the fiscal year ending September 30th, 1917, and have found them correct.

WILLIAM P. BAILEY,
JAMES P. TOBIN,
Auditors of Public Accounts.

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 196 NOVEMBER, 1917

ECONOMY IN FEEDING THE FAMILY

I

Some Essential Facts Regarding Nutrition

By *JOHN PHILLIPS STREET* and *E. H. JENKINS*

CONTENTS

	Page
The Uses of Food	4
The Chemical Composition of Food	4
The Uses of Proteins, Carbohydrates and Fats	5
How the Quantities and Fuel Values of Food Ingredients are Expressed	6
How Many Calories does the Body Need Daily?	8
Tables Showing Calories in one "Portion" of Various Foods	10

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to others as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF.

BOARD OF CONTROL.

His Excellency, Marcus H. Holcomb, *ex-officio*, *President*.

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Chemistry.	
Analytical Laboratory.	John Phillips Street, M.S., *Chemist in charge.* E. Monroe Bailey, Ph.D., C. B. Morison, B.S., C. E. Shepherd, W. L. Adams, B.S., M. d'Esopo, Ph.B., *Assistants.* Hugo Lange, *Laboratory Helper.* V. L. Churchill, *Sampling Agent.*
Protein Research.	T. B. Osborne, Ph.D., D.Sc., *Chemist in Charge.* Miss E. L. Ferry, M.S., *Assistant.*
Botany.	G. P. Clinton, Sc.D., *Botanist.* E. M. Stoddard, B.S., *Assistant Botanist.* Florence A. McCormick, Ph.D., *Scientific Assistant.* G. E. Graham, *General Assistant.*
Entomology.	W. E. Britton, Ph.D., *Entomologist; State Entomologist.* B. H. Walden, B.Agr., *First Assistant.* Q. S. Lowry, B.Sc., I. W. Davis, B.Sc., M. P. Zappe, B.S., *Assistants.* Miss G. A. Foote, B.A., *Stenographer.*
Forestry.	Walter O. Filley, *Forester; also State Forester and State Forest Fire Warden.* A. E. Moss, M.F., *Assistant State and Station Forester.* Miss E. L. Avery, *Stenographer.*
Plant Breeding.	Donald F. Jones, M.S., *Plant Breeder.* C. D. Hubbell, *Assistant.*
Vegetable Growing.	W. C. Pelton.

Economy in Feeding the Family.

This country is at war for the defense, both of our civil institutions and of our public and private property. It is a war which will be decided not, like most previous wars, by generals and armed men alone, but by the great home army of producers and savers. Its outcome depends largely on efficient production on the farm and self-denial in the home.

For the first time in our history the food supply of the country is not sufficient to meet the demands for it and those in authority call on the whole population to reduce to the utmost their use of wheat, beef, pork, sugar and animal fats.

This reduction is quite possible if done reasonably. A sudden and very radical change of diet, however, if not wisely made, may result in harm to many individuals.

It is most urgent that those who provide the food of families should have a clearer understanding of the principles of nutrition, of the amount of food necessary for health and efficiency and of the most economical methods of buying and preparing food. At present, there is much more thought, care and skill shown in selecting the rations of dairy stock and swine than in selecting the rations for human beings.

This and the following bulletins are meant to help in the diffusion of this necessary knowledge. We are aware that the same ground has been covered in many respects more fully and adequately in various books, but the fact that these are not so likely, as are our station bulletins, to reach the families of this state justifies our attempt.

There is also much work of our own station which is directly useful at this time and will here be noticed. This was one of the first of the stations to undertake the examination of foods. For many years its chemical department has been engaged in their analysis and in finding and exposing inferior and adulterated foods.

The researches of Osborne conducted here for many years on the constitution of the protein bodies and the later studies of Osborne and Mendel on animal nutrition have shown that many former assumptions regarding the role of proteins in food were far from the truth and have prepared the way for a great advance in the economy of feeding particularly in the use of proteins.

Preliminary to any comparison of different kinds of food material, a brief statement is needed regarding

THE USES OF FOOD.

Food has two distinct uses. It builds the body up to its adult size and from day to day repairs the wear and tear which life involves; for the body is a machine which only can be repaired while it is running and when it stops can never be started.

Food is the Builder and Repairer.

The other use of food is to furnish power sufficient to run this machine at the required rate of speed. Food is the fuel which gives power to the body, just as coal is the fuel which gives power to the steam engine.

Food is the source of all the body's Energy.

THE CHEMICAL COMPOSITION OF FOOD.

The nutriment in human food chiefly consists of proteins, carbohydrates, fats and mineral matters along with certain unidentified bodies (vitamines) which are present in very small amounts but are of great importance. Most foods also contain water and vegetable foods contain woody fiber besides, which has no nutritive value for human beings.

Proteins, of which the white of eggs, the curd of milk and gluten of wheat are types, are very complex substances, each being an aggregation of fifteen or more complex bodies (amino-acids) all of them containing nitrogen as a characteristic ingredient, so that foods which contain much protein are commonly called nitrogenous foods. Such foods are fish, eggs and meats of all kinds. Protein is also an important ingredient of milk and with fat makes up most of the substance of cheese.

*Important sources of **protein** are **poultry, fish**, eggs, **milk, cheese**, dried beans and dried **peas.***

It appears that the animal proteins, poultry, fish, eggs and milk, are more valuable as food than those of vegetables and among the vegetables themselves there are great differences. For this reason *milk or meat, in moderate quantities, should make a part of the daily ration, especially that of children.*

Fats scarcely need definition. *Butter, oleomargarine, lard and vegetable oils consist chiefly of fats; and cream, milk, cheese, and certain fish, like salmon, are rich in fat.* Fats are a more costly part of the ration than the other group of energy producers, the carbohydrates.

Carbohydrates are compounds of carbon, hydrogen and oxygen. Common examples are starch and sugar. While there are other carbohydrates than these, starch and sugar make up the bulk of the carbohydrates in human food.

Rice, potatoes, bread, macaroni and corn are all important sources of carbohydrates. They contain protein and fat as well, but their main constituent is starch.

Mineral matters, or ash, are such things as salt, phosphates, etc., which are found in most foods in small amount and which remain as ashes if the food is completely burned. They are necessary to the body, but in a mixed diet rarely need consideration.

"It is evident," says Lusk, "that the science of nutrition includes something more than the production of energy from fats, carbohydrates and protein. There must be certain salts and certain qualities of protein in the diet and there must be minute quantities of vitamines."

Concerning vitamines we have not yet very certain knowledge, but that they are growth-promoting substances and necessary in food seems certain. In a mixed diet containing both animal and vegetable food, probably vitamines are never deficient.

THE SPECIAL USES OF THE PROTEINS, CARBOHYDRATES AND FATS OF THE FOOD.

Proteins: To meet the first named use of food; namely, to build and repair the body, is the chief use of the proteins. They are the flesh builders. No other food ingredient can take their place.

One-fifth of the water-free substance of an active man consists of body proteins which are built and repaired from the proteins of the food.

An adult at very moderate work must have for his support at least 75 grams or 2⅔ ounces of protein daily.

To meet the second requirement; namely, to supply the power and heat on which life and ability to work depend, is the chief use of the fat and carbohydrates, though the proteins may join in this work when supplied in excess.

Power and heat are produced in the body in the same way as in the furnace of a steam boiler; namely, by the combustion of fuel. Fat, sugar, starch, etc., are chiefly used for fuel. They are burned in the body, forming carbonic acid and water, which are given off in the breath or through the skin and kidneys: But in the process energy is developed which shows itself in forms of work—the unconscious work of the heart and of the muscles which control breathing and do the other housework of the body—as well as in conscious work of all kinds. Incidentally much more than enough heat is produced to keep the body temperature at about 98°F.

Just as coal in the steam engine is burned chiefly to furnish power to the machinery, so food is burned to do the work of the body.

When eaten in quantity more than sufficient to supply energy the fats may also take part in the formation of body fats which serve as stored fuel for emergencies.

How the Quantities of Food Ingredients and Their Energy Are Expressed.

The quantities of protein, fat and other substances which make up a given article of food can be given in weight, ounces or grams, but are usually given in percentages—that is, in parts per 100.

Energy, however, cannot be directly expressed in terms of weight or per cent. Yet we must have an accurate measure of it in order to state at all accurately the amount of energy which the body needs, or a given food supplies. *This measure of energy is the Calory.*

As the foot is a standard for measuring length, so the calory is a standard for measuring heat energy. *A calory is the quantity of heat required to raise the temperature of a kilogram of*

water one degree Centigrade (or to raise the temperature of about four pounds of water 1°Fahr.) This quantity can be very accurately determined in any food by means of an elaborate apparatus called a calorimeter. Many careful experiments with a great number of food ingredients have shown that an ounce of pure protein or of a pure carbohydrate will yield 116 calories or heat units and an ounce of pure fat 264 calories; that is, a given amount of fat has about 2.25 times as much heat value as the same amount of either protein or carbohydrates.

Otherwise stated, one gram of either protein or carbohydrates yields 4.1 calories and one gram of fat yields 9.3. For general use these values may be simplified to 4 and 9.

It appears that proteins and carbohydrates have the same value for energy production, and fats have more than twice this value. The carbohydrates and fat are to a certain extent interchangeable in the diet; that is, in his diet one may get from fat more or less energy, or capacity to do work, according to his taste, or for reasons of economy.

The above explanation will make clear the meaning of the printed analyses of food. For example, the average composition of bread in the Connecticut market as shown by our recent analyses is:

	Per cent. (Parts per 100.)
Water	33.8
Ash	1.4
Protein	9.7
Carbohydrates	53.8
Fat	1.3
	100.0

Calories in 100 grams, 266.

The calories as thus calculated:

Protein and carbohydrates, $[(9.7+53.8)=63.5]\times4=254.0$.
Fat, $1.3\times9=11.7$.

Total, 265.7.

To calculate the calories in an ounce, multiply the calories in one gram by 28.4.

How Many Calories Does the Body Need Every Day?

The amount of fuel needed to run any kind of machinery of course depends on the amount of work which it is doing. The same is true of the human being. When more work or harder work is done, more energy, that is, more food, is needed.

It is clear then that the number of calories required in the day's ration varies with the amount of physical exertion. The age, sex and body weight also influence the food requirement. For instance, there are many adults who sit at their work and whose physical exercise is limited to their daily walk to and from work. These require about 2,500 calories daily. Those who chiefly stand during their working hours require 3,000. When the muscular work is constant but not heavy, 3,300 calories. Farmers need 3,500, stone masons and lumberman 4,500 to 5,000, and so on.

The following table summarizes these calory requirements from the standpoint of age and of occupation:

Approximate Number of Calories Required Daily.

Based on Age.		Based on Occupation.	
1 yr.	950	Clerk at desk	2,250
2 yrs.	1,100	Professional man, machinery watcher	2,500
3— 4 yrs.	1,300	Man at light muscular work	2,800
5— 6 yrs.	1,400	Bakers, dentists, shop-keepers, conductors	3,000
7—10 yrs.	1,500	Carpenters, painters	3,300
11—14 yrs.	1,600	Farmers	3,500
15—16 yrs.	2,100	Excavators	4,000
17—18 yrs.	2,250	Stone masons	4,500

A ration may contain, however, the proper number of calories and yet be a very poor ration if the protein, fat and carbohydate are not supplied in proper relative amounts. For instance, 0.7 lb. of butter, or 1.2 lbs. of American cheese, or 1.3 lbs. of sugar, would each yield 2,500 calories, yet it is apparent that none of these foods used alone, even in these amounts, would constitute a proper ration.

The normal man of sedentary habits, or performing light labor, should receive each day 2.6 oz. of protein, 1.8 oz. of fat and from 14 to 18 oz. of carbohydrates, yielding 2,500 calories. In the selection of food these relations must be kept in mind.

The average American dietary contains an excess of protein; that is, *we eat and in the body destroy more protein than the body needs to repair its tissues.* This excess protein has no greater fuel value than so much sugar and starch, and when we remember the difference in cost the great economic waste in this excess consumption of meat and other protein foods is apparent. *A properly constituted ration should contain from one-eighth to one-sixth of its calories in protein.*

A typical ration containing 1,000 calories is given by Lusk as follows:

	Ounces	Calories
Cooked Beans	7⅜	400
Pork	1	234
Bread	2 1-3	180
Butter	½	103
Milk	5	100
Coffee	5	——
Total		1,017

In this ration the protein yields nearly one-sixth of the calories, and the balance is therefore correct. In normal times such a ration would supply one-third the daily need of a man at light work at a cost of 4.25 cents, including the cost of fuel. It shows how cheaply one can supply his body with all of the needed nutriment when normal prices prevail.

How Shall This Knowledge of Calories Be Applied in the Preparation of the Daily Meal?

It would be most fortunate if tables showing the composition of our staple foods could be in every home.* However, even were this the case, many would have great difficulty in making the proper calculations from them.

Gephart and Lusk have greatly simplified this problem. Their extensive study of the standard portions served in a series of chain restaurants in New York City gives us just the data we require. It is quite probable that these portions represent closely

* Such tables by Atwater and Bryant are given in Bulletin 28 of the Office of Experiment Stations.

The tables are also contained in the Report of the Storrs Agricultural Station 1899, p. 111, a limited number of copies of which are available for distribution in this State.

CALORIES YIELDED BY STANDARD PORTIONS OF FOOD.

Food.	Weight of Portions.	Calories in Protein.	Calories Total.
	ozs.		
Apple, baked..	.4	1.4	137.2
" " and cream......	.8	5.8	393.7
*Bacon, broiled	6.5	70.2	760.8
*Bacon and eggs	8.5	**148.1**	818.1
Bananas, sliced	3.5	5.6	91.5
†Beans, Boston baked......	9.0	**102.1**	509.4
†Beef, corned beef hash with poached egg.........	6.25	**157.3**	680.0
†Beef, corned beef hash, browned....	7.0	**97.5**	538.3
†Beef, creamed chipped......	10.0	**160.1**	536.3
†Beef, roast, cold........	5.5	**155.7**	464.2
†Beef, roast, and mashed potatoes.....	10.5	**141.8**	539.6
Bread and butter, ¾ in. slice 1 tsp. butter	2.75	28.0	202.0
Bread, hot corn	5.5	60.5	474.1
Cakes, wheat, and syrup....	6.5	49.9	476.2
Cantaloupe....	4.5	4.1	37.4
Chicken croquette and French fried potatoes....	6.5	**77.5**	499.7
†Chicken hash.	6.5	**97.1**	468.1
Cocoa.........	9.0	32.9	256.7
†Codfish, creamed, on toast........	9.5	**155.6**	567.8
Coffee, cup, cream and sugar.......	11.5	27.5	202.9
Corn, stewed..	2.5	7.0	54.5
Corn flakes and milk.........	9.0	**54.7**	237.5
Corn starch with cream...	6.0	27.4	239.3
Crackers, graham........	2.0	21.4	230.1
Crackers, soda, and milk.....	10.5	**71.6**	397.4
	ozs.		
Cream.........	8.5	35.5	515.9
Cream of wheat	7.0	**32.9**	135.2
Crullers........	4.0	46.0	457.0
Custard, cup...	7.0	**53.4**	234.1
Eclair, chocolate........	2.5	19.2	193.4
†Eggs, boiled (2).........	4.5	**92.8**	391.0
†Eggs, creamed on toast.....	9.0	**146.6**	663.9
†Eggs, fried (2)	6.0	**105.8**	527.8
†Fish cakes and poached egg.	9.0	**129.5**	603.8
†Frankfurts and potato salad.......	10.0	**114.0**	619.8
Grape fruit.....	7.0	6.3	79.0
*Ham, broiled.	9.0	**158.0**	936.7
*Ham and eggs	10.0	**181.9**	842.6
Ice cream, vanilla.........	5.0	21.9	233.7
*Lamb chops (2).........	5.5	**146.5**	852.9
*Liver and bacon..........	9.0	**177.5**	797.2
†Macaroni and cheese......	9.0	**69.5**	382.8
Maple flakes with milk...	9.0	**64.0**	283.4
Milk..........	16.0	**79.0**	312.8
Muffins, corn..	3.5	35.9	352.3
Oatmeal and cream......	10.0	47.1	396.3
†Omelet, plain.	6.0	**117.2**	529.5
Oysters, raw...	3.5	**32.0**	64.9
Pie, apple.....	5.0	20.9	343.1
Pie, mince....	6.0	45.9	401.1
Potatoes, French fried.	5.0	31.8	329.8
Pudding, bread custard......	7.0	**56.8**	371.4
Pudding, rice, cold........	8.0	**43.6**	275.4
Pudding, apple tapioca......	8.0	29.4	225.5
Rhubarb, stewed.......	4.0	4.0	95.0
Rice, boiled....	6.0	17.0	135.6
†Salad, crab meat........	8.5	**140.9**	437.7

CALORIES YIELDED BY STANDARD PORTIONS OF FOOD—Continued.

Food.	Weight of Portions.	Calories in Protein.	Calories Total.	Food.	Weight of Portions.	Calories in Protein.	Calories Total.
	ozs.				ozs.		
†Salad, potato	10.0	50.9	448.3	†Soup, vegetable	9.5	35.1	206.1
Sandwich, club	4.5	**111.3**	438.6	*Steak, Hamburger	10.0	**147.9**	723.8
" fried egg	5.0	**59.8**	276.0	*Steak, small	10.0	**237.5**	1032.8
" ham	2.0	**48.4**	212.1	†Stew, beef	16.5	**148.4**	641.4
" roast beef hot	3.5	**69.3**	263.9	†Stew, lamb	15.0	**146.8**	622.2
Sandwich, Swiss cheese	2.0	**51.5**	258.5	Toast, buttered	2.5	42.7	311.3
Sausage, country	3.0	**57.6**	243.9	Toast, milk	8.0	**59.4**	333.5
Sausage and fried potatoes	6.0	71.5	521.7	Tomatoes, sliced	5.0	**6.7**	32.2
Shredded wheat and cream	6.0	56.4	494.5	Tomatoes, sliced, with lettuce	4.5	8.2	52.1
Shredded wheat and milk	10.0	**81.2**	404.5	†Veal cutlet and tomato sauce	13.0	**177.8**	897.8
Soup, bean, with croutons	10.5	**42.5**	180.8	Watermelon	38.0	27.6	244.3
†Soup, split pea	9.0	**45.9**	241.1				

* Potatoes and bread and butter served.

† Bread and butter served.

enough the amounts served in the average home, to be a useful guide in making up rations and in substituting cheaper for more expensive foods.

The foregoing table is an abridgment of their tables, somewhat simplified and recalculated in common terms.‡ The first column gives the food served, an asterisk (*) indicating that bread and butter and potatoes were served with it, and a dagger (†) that bread and butter were served; the second column gives the approximate weight of the portion in ounces; the third column, the calories yielded from the protein in the portion; and the fourth column the total calories yielded.

Two important points must be kept in mind in using this table. A considerable portion of the protein in the ration should come

‡ Anyone interested in the facts which they give will find the full compilation in a pamphlet of 84 pages, Analysis and Cost of Ready-to-Serve Foods, by Gephart and Lusk, published by the American Medical Association, 535 N. Dearborn St., Chicago, Ill.

from animal sources, such as poultry, milk, fish or eggs; and about 15 per cent. of the total calories should be derived from the protein. The name of the dish will generally indicate whether animal protein is present, and in the protein calories column full faced type is used where at least 15 per cent. of the total calories is derived from protein.

To illustrate the practical use of the table: portions of Boston baked beans, chicken croquettes, creamed codfish on toast, two fried eggs (all four served with bread and butter) and cream, wheat cakes with syrup, and crullers, all yield about 500 calories per portion, and approximately five portions of each of these would be necessary to supply the daily requirement of 2,500 calories. These seven foods may be divided into two groups. The first four derive at least 15 per cent. of their calories from protein, and in all but the baked beans this protein is chiefly from an animal source; the last three foods are all deficient in protein. It is obvious, therefore, that cold roast beef, creamed codfish and fried eggs might be interchanged in the daily ration without disturbing the balance and at the same time supplying proper nutriment. In other words, five portions of any of these three foods served with bread and butter would provide sufficient protein and calories for the daily need of a light worker. Five portions of baked beans would not do this, for while the total nutriment would be sufficient, no animal protein would be supplied. Five portions of either cream, or wheat cakes, or crullers, would be unsatisfactory because in each case too little protein would be provided.

Of course, the foregoing illustration is not meant as a suggestion to limit one's daily food to cold roast beef, creamed codfish and fried eggs, served with bread and butter. Such a ration would be adequate, and probably for a limited time might be satisfactory, but personal taste must rule in suggesting modifications of this ration which will increase variety and palatability and which will furnish bulk, a characteristic wanting in many American meals and one most essential to health.

The foregoing table may also be used to determine whether the daily food (ration) is adequate or excessive.

To illustrate, there follows a day's bill of fare of one of the Station staff and the corresponding energy value (calories) as given in the table:

	Calories In Protein.	Total.
Breakfast;		
One cup coffee with cream and sugar	27.5	202.9
One apple	1.4	137.2
Oatmeal and milk	50.2	281.0
One thick slice rye bread and butter	28.0	202.0
Dinner		
Bean soup with croutons	42.5	180.8
Roast beef and mashed potatoes	141.8	539.6
Stewed corn	7.0	54.5
Apple tapioca pudding	29.4	225.5
Supper		
Macaroni and cheese	69.5	382.8
Two slices rye bread and butter	56.0	404.0
Apple sauce	2.8	274.4
Chocolate layer cake	20.7	218.3
	476.8	3103.0

It appears that the calories in the protein of the ration make 15.4 per cent. of the total calories, which is near to the standard 15. The total calories, however, considerably exceed the standard of 2,500.

Considering, however, that the portions given in the table are restaurant portions and rather larger on the average than a man at light work takes at his own table, the ration seems satisfactory. On the "meatless" days creamed codfish, fish cakes and poached egg, or plain omelet will be substituted for roast beef or any other meats.

The foregoing discussion concerns the principles of nutrition and may be helpful as a general guide to the housewife in the control of diet. On her, in the final analysis, depends very largely the efficiency of the community.

Her first problem is to supply enough palatable and nutritious food for the family. It is false economy at this time in any way to make the diet less efficient.

The next problems are—to save the family expense and to lessen the home demand for such foods as wheat, beef and pork, sugar and fats, which are needed to send abroad to our own and our allies' armies. In families with very small incomes the first

of these two problems is the more pressing; in families with larger incomes patriotism requires personal sacrifice in the matter of family expense, when it is necessary for a great national work. For instance, families with very limited means cannot substitute poultry and eggs for beef or pork, when the former are more expensive. The well-to-do can and should do this, so far as practicable.

Economies are to be effected by personal instead of telephone marketing, by getting a variety of food which includes a liberal supply of vegetables, by skill in adapting the diet to personal differences in taste and in efficiency of digestion, as well as in the preparation of attractive and appetizing dishes.

If any very radical change in diet is to be made, it should be brought about gradually. A sudden or violent change is likely to produce disturbance of digestion and temporarily, at least, impair efficiency. Many people, for instance, would be seriously affected if rye or corn bread were eaten to the exclusion of wheat bread, for a period of two weeks, and would be prejudiced against any use of them forever afterwards. If, however, either rye or corn breal is used at first quite sparingly and not continuously, it may come to be regarded rather as a grateful change and as a delicacy than as the outward and visible sign of an inward and spiritual resignation to the physical hardship of wartime. The use of these wheat substitutes, therefore, begun in this way, is more likely in the end to lessen the family consumption of wheat, than a more sudden and radical change. It may, indeed, create a tolerance for and a liking of them which will outlast the war and be of considerable economic advantage.

Feeding a family has a psycological side which is often overlooked. The mental attitude of the family, as well as the cookbook, needs to be studied.

The following books treat of the various phases of the science of nutrition and can be recommended to those who wish to become more fully acquainted with the subject:

Mendel, L. B.	Changes in the Food Supply and their Relation to Nutrition. Yale University Press, New Haven............	$0.50
Lusk, Graham.	The Basis of Nutrition. Yale University Press, New Haven............	.50

Sherman, H. C.	Chemistry of Food and Nutrition. MacMillan, N. Y.	1.50
Stern & Spitz.	Food for the Worker. Whitcomb & Barrows, Boston	1.00
Green, Mary.	Better Meals for Less Money. Henry Holt & Co., N. Y.	1.25
Rose, Mary S.	Feeding the Family. MacMillan, N. Y. .	2.20
Rose, Mary S.	Laboratory Handbook for Dietetics. MacMillan, N. Y.	1.10
Gephart & Lusk.	Analysis and Cost of Ready-to-Serve Foods. Amer. Med. Assn., Chicago.	

Connecticut Agricultural Experiment Station

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ECONOMY IN FEEDING THE FAMILY

II

The Cereal Breakfast Foods

By JOHN PHILLIPS STREET

CONTENTS

	Page
Types of Cereal Breakfast Foods	19–22
Composition	22
Comparative Food Value	22–24
Digestibility	24–25
Cooking	26
Cost	27
Suggestions as to Purchase	29–31

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Cereal Breakfast Foods.

The cereal foods occupy a very important place in the diet of the American family, both in sickness and in health. Vegetable foods supply about 95 per cent. of the carbohydrates in the average dietary, and the cereal foods themselves supply fully 55 per cent. Grains in the raw state are unattractive to the taste and are somewhat difficult of digestion, and for this reason cereals are generally cooked before eating. The oldest method of cooking them was by parching, and in the early days the Scotchman's oatmeal and the Indian's maize were prepared in this way. The next development was porridge, in which the grain was boiled or steamed with water, milk or meat stock, and thus rendered more palatable. Porridge, however, requires long cooking, its keeping qualities are poor, and it is far from being a convenient food preparation. In spite of these disadvantages—and the necessary long cooking is by no means an unqualified disadvantage—porridge has enjoyed a wide use and popularity, and the modern cereal breakfast food is its lineal descendant.

A generation ago practically the only cereal foods on the market were wheat flour, corn meal, hominy and hulled corn; barley, rye and rice finding only a very limited use. At the present time we find an almost endless number and variety of specially prepared breakfast foods offered for our use. Many of the brands, however, are exploited by extensive and expensive advertising and live only so long as a fluctuating public taste demands them. Some endure but for a season, while others have taken a fixed place in the long list of American food materials.

Types of Cereal Breakfast Foods.

However, while the brand names of the foods may change, the types of cereal breakfast foods which they represent persist from year to year. There are four main types of these foods: those in which the grain is simply husked and more or less crushed or ground; those which have been steamed or partially cooked at the factory and then ground or rolled and dried; those which have

been cooked by dry heat only, such as puffed rice or wheat; and those in which more or less of the insoluble starch has been converted into soluble form by the action of barley malt, as in the so-called malted foods.

The grains used in this country in these products are oats, wheat, corn, rice, and less commonly barley and rye. Althougb the various flours, starches, and edible cereal pastes (noodles, macaroni, vermicelli and spaghetti) are in a sense cereal breakfast foods, they will not be discussed at this time.

Oats is characterized by its high protein and fat content; wheat, rye and barley by high protein and moderate fat; corn by its relatively high fat; while rice is distinctly low in protein, and in the polished form almost free from fat, fiber and ash. These characteristics of the individual grains greatly affect the composition of the breakfast foods made from them, as will be shown later. In the preparation of certain breakfast foods the grain is used in its entirety; in others more or less of the germ is removed, thus materially reducing the percentage of fat; in others the ground product is thoroughly bolted to remove most of the fiber; while in still others the use of heat or a malting process materially alters the form of carbohydrates present. To certain of the "ready-to-eat" brands, salt, sugar, syrup, or honey has been added, thus increasing the ash or carbohydrates and decreasing the relative percentages of the other ingredients. In general, however, the composition of the finished breakfast food closely follows that of the parent grain.

Barley is not a popular breakfast cereal in this country, and when used it is usually in the form of "pearled" barley with a much lower content of fiber and considerably less of all the other ingredients, except carbohydrates, than the unhulled, untreated grain.

The germ of the corn kernel is rich in fat, which tends to become rancid on keeping, and more or less of it is generally removed in the preparation of corn breakfast foods. Hominy, samp and cerealine are names used quite loosely for corn products, which differ little from one another in composition, save that hominy generally carries a little more fat. They are all essentially carbohydrate foods. The toasted and flaked corn preparations are steamed and rolled grains, which have been

cooked longer, and to which salt and a sweetening material are commonly added.

In the oatmeal of our forefathers much of the hull or husk remained in the ground product, but with modern improved processes more of the fibrous hull is removed. The germ is not removed from the oat preparations. In the crushed or flaked oat foods the grain is more or less cooked with steam, and while still moist rolled into thin flakes and dried. Such products are, of course, only partially cooked, and further cooking is necessary before using.

The rice foods come to us either flaked, or as "puffed" rice. In the latter form the rice has been treated by a special process of cooking with dry heat, the resultant product resembling somewhat popcorn in flavor and texture.

In the preparation of wheat breakfast foods the germ, as a rule, is not removed, and save in farina and the gluten preparations more or less of the bran and middlings are retained. In certain products the whole grain, bran and all, is used. The unground wheat grain is seldom used as breakfast food, except in the "puffed" products (prepared similarly to puffed rice), and in frumenty, in which the husked grain is boiled with milk and spices. The latter preparation has but a restricted use in this country. Where the grain is only moderately crushed and the bran not removed, the product is known as cracked wheat or wheat grits. The flaked wheat foods are prepared in the same way as rolled or flaked oats. Shredded wheat is prepared by a special process and represents the whole grain. The gluten breakfast foods are characterized by a very high protein content and contain only about half the starch usually found in wheat foods. They are intended primarily for those to whom much starch in the diet is objectionable, but as a rule the extent to which the starch has been removed falls far short of the manufacturer's claims.

In the so-called malted foods advantage is taken of the diastatic power of barley malt, the diastase of malt imitating the action of the ferments of the saliva and pancreatic juice. Generally the amount of malt added is not sufficient to convert more than a part of the starch into soluble forms. Analysis shows that in many of these foods the soluble carbohydrates

exist largely in the form of dextrin and suggests the possibility of glucose or some other soluble dextrin-containing carbohydrate being added. Furthermore, it must not be forgotten that the treatment of starch with dry heat also produces dextrin, as illustrated in the case of ordinary toast. It is evident, therefore, that many of these "malted" foods are not deserving of the name.

Still another group of breakfast foods now quite widely used includes the various laxative preparations. These usually consist chiefly either of wheat bran or some inert material, such as agar-agar or Iceland moss. In some instances fruits and nuts are used and occasionally an oil, such as olive oil, or linseed oil.

Composition of Cereal Foods.

Aside from the constituent grains and the method of manufacture, the cereal breakfast foods are of two general classes, those which are either raw and which need prolonged cooking or which have been cooked to some extent and need further treatment before use, and those which are "ready-to-eat." Pearled barley, hominy, samp, corn meal, oat flakes, cracked wheat and farina are types of the first class, while among the "ready-to-eat" preparations we find such products as cerealine, corn flakes, rice flakes, wheat flakes, puffed rice, shredded wheat, Grape-nuts and some of the various "malted" foods. Table I, pages 32 to 39, gives the analyses of 130 of these products examined in this laboratory between 1909 and the present time, 32 being analyses just made. In addition to the chemical composition the claimed weight of the package (which was generally found to be correct) is given together with the calories yielded by one-fourth pound of the food, and the cost per package, per pound and per 100 calories. The costs are based on New Haven prices maintaining on September 26th of this year. These costs will be discussed in more detail later.

Comparative Food Value of the Cereal Breakfast Foods.

In order that the relative composition of these foods may be shown more clearly, an abridged table, Table II has been prepared, in which the average data for the different types are given, grouped under the two headings, "to be cooked" and "ready-to-serve." See pages 24 and 25.

Among the foods requiring further cooking the superiority, from a nutritive standpoint, of the oat meals is apparent at a glance. They contain from 50 to 100 per cent. more protein and from three to nine times as much fat as the other "to-be-cooked" products. In fact, they are the only breakfast foods, aside from certain laxative preparations, that contain any considerable percentage of fat, and indeed for this reason they have been criticized as "heating" foods and undesirable for use in hot weather and by people suffering from certain types of disease. An average serving of rolled oats, however, contains only about 1 1-3 ozs. of the dry cereal, and a daily consumption of this amount for four months would supply only about as much fat as 2-3 lb. of butter. The "heating" effect of oat preparations, therefore, obviously may be neglected except under most unusual conditions. If oatmeal supplies so little fat in the ordinary dietary, it is apparent that the amounts supplied by the other "to-be-cooked" cereals is almost negligible. This further emphasizes the fact that, while these foods contain important percentages of protein, they are, with the exception of the oatmeals, essentially carbohydrate foods.

While among the "ready-to-eat" preparations considerable variations are shown in all the ingredients except the carbohydrates, the most striking differences, as we have shown elsewhere, are in the amounts of carbohydrate rendered soluble in water by the various manufacturing processes. Only about 10 per cent. of the carbohydrates of flaked rice, *Shredded Wheat* and *Triscuit* are water-soluble, raising a serious question as to the desirability of the extensive use of such foods in the dietaries of young children. Flaked wheat shows only about 15 per cent., while on the other hand, flaked corn shows 26, puffed rice 32, puffed wheat 27 and *Grape-Nuts* 36 per cent. of water-soluble carbohydrates.

From a nutritive standpoint, the table shows that these types of breakfast foods, excepting possibly the oatmeals and *Holland Rusk,* are practically interchangeable. While one-quarter of a pound of oatmeal or Holland Rusk yields 430 calories, the same quantity of each of the other foods listed yields approximately the same number of calories, 400. For all practical purposes, therefore, it may be assumed that one ounce of any of the commonly used breakfast foods yields about 100 calories. An attempt has been made in the table to indicate in terms of familiar

TABLE II.—AVERAGE COMPOSITION AND COSTS OF

Type.	Pounds per hundred. Protein.	Fat.	Carbo-hydrates.
To Be Cooked.			
Corn meal	7.5	0.8	78.7
Hominy and samp	7.9	0.7	76.9
Oat meal (Bestovotes)	16.2	6.6	63.1
Oats, rolled	15.6	6.6	64.4
Groats, Robinson's	12.8	8.6	67.7
Farina	10.9	1.3	74.4
Wheat, flaked	11.1	2.1	73.4
Wheat, cracked	9.3	2.3	73.3
Post Tavern Porridge	10.3	0.8	74.5
Ready To Serve.			
Corn flakes	6.9	0.3	78.6
Corn, puffed	8.7	0.3	78.5
Rice flakes	10.0	0.4	81.3
Rice, puffed	7.6	0.2	79.5
Wheat flakes	9.3	1.1	80.5
Wheat, puffed	13.1	1.8	70.2
Wheat, shredded	11.0	1.4	75.0
Triscuit	11.0	1.4	73.9
Force	10.6	1.1	73.7
Grape-Nuts	11.5	0.6	74.2
Holland Rusk	12.1	5.1	70.4
Kellogg's Krumbles	12.0	1.2	72.3

measure the volume of the different foods weighing one ounce and yielding 100 calories. For instance, 1 *Shredded Wheat* biscuit, 2½ *Triscuits*, 2/5 cup rolled oats, 1¼ cups corn flakes, or 4 heaping tablespoonfuls of *Grape-Nuts* each yields 100 calories and weighs about one ounce.

DIGESTIBILITY OF THE CEREAL BREAKFAST FOODS.

The value of a food depends not only upon the amounts of nutrients present but also upon their digestibility. Experiments with healthy men have shown that partially cooked wheat preparations have the highest digestibility and those made from unbolted wheat the lowest. Experiments at the Maine Experiment Station with rolled oats, rolled wheat, corn meal, hominy and certain

TYPICAL BREAKFAST FOODS IN PACKAGE FORM.

Cost.			Calories per ¼ lb.		Necessary to yield 100 Calories.	
Per pound.	Per 100 calories.	Per serving.	Total.	From protein.	Volume.	Weight.
cts.	cts.	cts.				oz.
8	0.50	0.81	402	34	1/5 cup*	1
10.5	0.66	1.01	401	39	1/6 "	1
10	0.58	0.74	430	73	1/5 "	0.9
9	0.56	0.75	432	71	2/5 "	1.1
50	2.74	3.50	456	59	1/5 "	0.9
13.5	0.86	1.31	403	49	1/4 "	1
10	0.61	0.64	408	50	1/2 "	1
15.5	0.97	1.80	401	42	3/10 "	1
10	0.63	0.89	396	47	1/5 "	1
18	1.18	0.97	394	31	1 1/4 "	1
37.5	2.33	1.83	402	39	1 1/3 "	1
30	1.78	1.37	422	45	1 1/3 "	1
56	3.50	2.45	400	34	1 1/4 "	1
30	1.78	1.46	422	42	1 "	1
60	3.76	1.99	399	60	2 "	1
16	0.98	1.00	408	50	1 bisc.	1
20	1.24	1.50	403	50	2 1/2 bisc.	1
17.5	1.10	1.40	397	48	1 cup	1
16	1.01	1.16	398	52	4 tablesp.	1
29	1.69	.....	430	55	.....	.....
16	1.01	2.05	398	54	1 cup	1

* A cup equals ½ pint.

specially prepared brands, showed that in general about 90 per cent. of the organic matter was digested. The general conclusion from these experiments was that rolled wheat showed the highest and the corn products the lowest digestibility, oats occupying an intermediate position. When the actual nutrients are compared with the total nutrients it is seen that the relation previously noted still maintains; that is, the oat preparations provide the largest amounts of digestible protein and fat, followed by wheat, rye and barley, while the corn and rice products supply but relatively small amounts of these elements and relatively large amounts of carbohydrates. Other Maine experiments bring out the interesting fact that the processes to which certain products

have been subjected during their manufacture, while converting a part of the starch into soluble carbohydrates, have at the same time diminished the digestibility of the protein. For instance, rolled wheat showed 85 per cent. protein digestibility, while *Force* and *Grape-Nuts* showed but 76 and *Shredded Wheat* only 58. These and other experiments show that the raw cereals, if sufficiently cooked, are as quickly and as easily digested as the best malted cereals, and more quickly than the ordinary prepared cereals and a large majority of the so-called malted cereals.

THE COOKING OF BREAKFAST FOODS.

The proper cooking of any food is a very important factor in its digestibility. Aside from the usefulness of heat in sterilizing food, the main purposes of cooking are to improve the food's appearance and flavor, to break down certain refractory elements and to convert the nutrients into more assimilable forms.

The manufacturing processes used in these foods—crushing, rolling, steaming, parching, puffing or shredding—all to a greater or lesser degree rupture the cells of the grain, and thus render the cell contents more susceptible to the action of the digestive juices of the body. As a rule, however, even some of the "ready-to-eat" foods come to us in a form which requires more cooking before their nutrients can become entirely available to the body. In the average home the over-cooking of cereals is most unsual; on the other hand, undercooking is all too common. This tendency is fostered by the claims of the breakfast food label, and we have offered to us "15-minute" oat flakes and similar alluring and alleged time-conserving preparations. The consumer has no way of knowing how much of the needed cooking has been performed by the manufacturer, and he may safely assume that the directions accompanying the food underestimate rather than exaggerate the time necessary for proper preparation. Frequently the prepared foods are condemned as indigestible simply because the cooking period has been too limited; but theoretically there is no reason why, if properly cooked, they should not be quite as digestible as cereals cooked entirely in the home. No hard and fast rule can be laid down as to the proper cooking period for the various cereals, but generally speaking the

greater the amount of husk or hull present the longer the food should be cooked.

Cost of Cereal Breakfast Foods.

In Table I the cost of the foods is shown on the basis of the package, the pound and the 100 calories. The cost is omitted in a number of instances, either because the food could no longer be found in this State or because, with the present greatly increased prices of all commodities, it was unsafe to assume any price for these without a direct inspection of the package as to its net contents. Omitting such unusual preparations as *Colax* and *Sea Moss Farina*, both in a sense medicine rather than food, the cost per pound ranges from 6.5 cents in a wheat bran to 76 cents in *Dieto Rusks*. Of the preparations requiring cooking, the corn products are the cheapest, followed by oats, with the wheat foods the most expensive. (*Robinson's Groats* is an imported food primarily intended for invalid use, and its high cost removes it from the category of family breakfast foods.) The specially prepared foods cost from two to seven times as much per pound as the simple cereal preparations, such as oatmeal, farina and hominy.

In a consideration of cost, however, composition must not be overlooked, and judged on this basis oatmeal is by far the cheapest of all the cereal breakfast foods. Nor must we forget that while we pay very much more for the prepared than for the uncooked foods, this price is in part justified by their convenience, and the saving in both time and fuel by the shortening of the home-cooking period. In hotels, hospitals and large establishments where a fire is kept throughout the day for other purposes, the prolonged cooking required by the raw cereals may be effected with practically no expense. In households where a gas stove is used exclusively for cooking, and then only at specified and limited times, it is indeed a question whether the "ready-to-eat" brands may not in many cases be the more economical purchase.

The Increased Cost of Cereal Foods.

In the case of 22 brands we have full data as to the size of the package and its cost for both the years 1909 and 1917. By referring to Table III it will be seen that in nearly every case the net

TABLE III.

COMPARATIVE PACKAGE WEIGHTS AND PRICES.

Brand.	1909.			1917.		
	Weight oz.	Cost cts.	Cost per lb. cts.	Weight oz.	Cost cts.	Cost per lb. cts.
Hominy	30	10	5.5	24	18	12
Hominy	31	6	3	74	43	9.5
Kellogg's Toasted Corn Flakes	10	10	16.0	8	11	22.0
Post Toasties	10	10	15.0	8	11	22.0
Quaker Toasted Corn Flakes	10	8	12.0	8	7	14.0
Quaker Yellow Corn Meal	46	12	4.0	24	12	8.0
Hornby's Oats	28	15	8.5	20	15	11.0
Quaker Oats	24	10	6.5	20	10	8.0
Quaker Puffed Rice	7.5	10	21.5	4	14	56.0
Cream of Wheat	28	15	8.5	28	22	12.5
Force	12	15	18.5	10	11	17.5
Grape-Nuts	16	12	12.0	13	13	16.0
Hecker's Farina	16	10	10.0	16	14	14.0
Holland Rusk	7	10	24.0	6	11	29.5
Malt Breakfast Food	30	15	8.0	28	22	12.5
Pettijohn's Breakfast Food	23	11	7.5	24	18	12.0
Premier Farina	16	10	10.0	16	14	14.0
Quaker Cracked Wheat	30	15	8.0	26	25	15.5
Saxon Wheat Food	25	15	9.5	26	22	13.5
Shredded Wheat	13	12	14.5	12	12	16.0
Triscuit	13	10	12.5	9.5	12	20.0
Wheatena	25	15	9.5	19	18	15.0
Ave. 6 corn products	..	..	**9.3**	..	..	**14.6**
Ave. 2 oat products	..	..	**7.5**	..	..	**9.5**
Ave. 13 wheat products	..	..	**11.7**	..	..	**16.0**
1 rice product	..	..	**21.5**	..	..	**56.0**

weight of the package has been reduced and in many instances the cost of the package increased. Hominy that in 1909 averaged 4 cents per lb. now costs 11 cents, corn flakes have increased from 14 to 19 cents, rolled oats from 7.5 to 9.5 cents, puffed rice from 21.5 to 56 cents, *Grape-Nuts* from 12 to 16 cents, farinas from 9.5 to 14 cents, cracked wheat from 8 to 15.5 cents and *Triscuit* from 12.5 to 20 cents per lb. Of the brands listed *Force* is the only one which costs no more per pound to-day than in 1909. On the average the corn products in the eight years advanced 57, oats 27, wheat 37 and rice 162 per cent. These startling increases emphasize the importance of intelligent buying of these widely used foods.

TABLE IV.

WEIGHTS OF ONE SERVING OF FOOD, CALORIES YIELDED, AND COST.

Food.	Weight of 1 cup (½ pint) of dry food.	Weight of one serving.	Total calories.	Per serving.	Per 100 calories.
Corn.	oz.	oz.		cts.	cts.
Corn flakes, Jersey	0.95	0.95	99	1.07	1.08
" " Kellogg's	0.78	0.78	76	1.07	1.40
" " Post Toasties	0.90	0.90	89	1.24	1.39
" " Quakers	*0.90	0.90	90	0.79	0.88
" " Washington Crisps	0.67	0 67	65	0.67	1.03
Corn meal, in bulk	5.40	1.62	163	0.71	0.44
" " Quaker	5.40	1.62	163	0.81	0.50
Corn puffs, Quaker	0.78	0.78	78	1.83	2.33
Hominy, Hecker's Cream	6.03	1.51	152	1.13	0.75
" Sunbeam	5.93	1.48	145	0.88	0.54
Roman Meal	5.40	1.62	161	1.00	0.63
Oats.					
Groats, Robinson's Patent	4.48	1.12	128	3.50	2.76
Oat Meal, in bulk	5.50	1.38	156	0.61	0.39
" " Bestovotes	4.76	1.19	128	0.74	0.58
" " Keen & Robinson's	5.54	1.39	156	1.91	1.22
" " McCann's	6.00	1.50	171	1.79	1.04
Oats, rolled, in bulk	2.50	1.25	140	0.55	0.39
" " Bufceco	2.68	1.34	145	0.67	0.46
" " Hecker's	2 68	1.34	142	0.67	0.46
" " Hornby's	*2 68	1.34	146	0.92	0.63
" " Leggett's	*2 68	1.34	142	1.01	0.71
" " Purity	2.68	1.34	140	0.67	0.46
" " Quaker	*2.68	1.34	144	0.67	0.47
" " Scott's	3.28	1.64	187	1.38	0.74
Rice.					
Rice, head, in bulk	7.00	1.75	175	1.31	0.75
" small, in bulk	7.00	1.75	175	1.09	0.63
" broken, in bulk	7.00	1.75	175	0.88	0.50
" flakes, Kellogg's	0.73	0.73	77	1.37	1.78
" puffed, Quaker	0.70	0.70	70	2.45	3.50
Wheat.					
Farina, Cream of Wheat	6.21	1.55	155	1.21	0.78
" Crystal Wheat	*6.05	1.51	154	1.37	0.89
" Hecker's Cream	*6.05	1.51	151	1.32	0.88
" Mother's Wheat Hearts	5.78	1.45	145	0.73	0.50
" Quaker (F. S.)	5.68	1.42	141	0.99	0.69
" Vitos	6.17	1.54	160	0.82	0.53
" Wheatena	*6.05	1.51	159	1.42	0.89
Wheat, cracked, Quaker	6.20	1.86	186	1.80	0.97
" flakes, Alber's	2.05	1.03	105	0.64	0.61
" flakes, Kellogg's	*0.78	0.78	82	1.46	1.78
" puffed, Quaker	0.53	0.53	54	1.99	3.62
Force	1.28	1.28	127	1.40	1.10

* Estimated from weight of similar preparations.

TABLE IV—*Continued.*

WEIGHTS OF ONE SERVING OF FOOD, CALORIES YIELDED, AND COST.

Food.	Weight of 1 cup (½ pint) of dry food.	Weight of one serving.	Total calories.	Per serving.	Per 100 calories.
	oz.	oz.		cts.	cts.
Wheat—Continued.					
Grape-Nuts (4 heap. tablespoonfuls)	1.16	1.16	115	1.16	1.01
Kellogg's Krumbles	2.05	2.05	204	2.05	1.01
Pettijohn's Breakfast Food	*2.05	2.05	208	1.54	0.74
Ralston Wheat Food	4.80	1.20	121	1.13	0.94
Shredded Wheat (1 biscuit)	1.00	1.00	102	1.00	0.98
Triscuit (3 biscuits)	1.20	1.20	121	1.50	1.24
Miscellaneous.					
Fruit Nut Cereal	4.13	1.16	117	1.52	1.30
Post Tavern Porridge	5.68	1.42	141	0.89	0.63

* Estimated from weight of similar preparations.

SUGGESTIONS AS TO PURCHASE.

In order to make a fair comparison of cost we must not lose sight of the fact that many of these foods are served in the dry condition as purchased, while others, such as oatmeal, farina and hominy, during the cooking process absorb large amounts of water. It is obviously unfair, therefore, to compare the nutrient value of one pound of raw oatmeal with one pound of corn flakes. To obviate this difficulty Table IV has been prepared showing the weights in ounces of the average individual serving for most of these foods. In preparing this table the cup (½ pint) has been taken as the unit of measure, and it has been assumed that an average serving of corn flakes, corn puffs, rice flakes, puffed rice, wheat flakes, puffed wheat, *Krumbles*, and *Force*, is one cup, that of corn meal and cracked wheat 3/10 cup, of oatmeal, hominy, rice, farina and *Ralston Wheat Food* ¼ cup, of rolled oats and flaked wheat ½ cup, of *Shredded Wheat* 1 biscuit, of *Triscuit* 3 biscuits and of *Grape-Nuts* 4 heaping tablespoonfuls. In some cases these servings may be somewhat excessive but they are at least comparative. Where the food was available we have weighed one cupful in each case and the weights are shown in the table. In certain cases an assumed weight has been used based on the known weight of a similar preparation.

Table IV also shows the number of total calories yielded by these servings, as well as the cost per serving and cost per 100 calories.

The main facts in this table are shown graphically and perhaps more clearly in the charts on pages 40 to 43. The one chart shows the relative cost of the foods per serving, the other the relative cost per 100 calories. In the main these two charts show similar results, the differences arising not so much from variations in composition as from the variations in weight of servings of the respective foods. The serving basis is perhaps the more popular way to consider the cost of these foods, but the 100 calories basis is clearly the more exact and the more scientific. Our consideration, therefore, will be on the latter basis.

The relative cheapness of the uncooked cereals is apparent, oats and corn showing the lowest costs and rice and wheat the highest. The highest priced foods under each cereal (excepting *Robinson's Groats* already referred to), are the "ready-to-eat" preparations, and among these there is a wide range of cost. Of the flaked foods, corn flakes are the cheapest, followed by wheat and rice; the puffed cereals show about the same relative cost. The most obvious facts shown by the charts are the cheapness of the rolled oat preparations, and that corn puffs, puffed rice and puffed wheat are clearly among the luxuries of the breakfast table.

TABLE I.—CEREAL

Date of Analysis.	Brand.	Water.	Fat.
	Barley Preparations.		
1913	Farwell & Rhines' Barley Crystals	9.9	1.3
1909	Quaker Scotch Brand Pearled Barley	12.1	0.9
	Corn (Maize) Preparations.		
1909	Cerealine	11.2	0.4
1909	E-C Corn Flakes, Toasted	12.1	0.3
1909	F. S. Granulated Hominy	13.3	1.0
1917	Hecker's Cream Hominy	11.7	0.4
1909	H-O New Process Hominy	11.3	0.3
1916	Jackson's Roman Meal	8.5	3.4
1917	Jersey Corn Flakes	7.7	0.3
1909	Kellogg's Toasted Corn Flakes	11.7	0.2
1909	Korn Kinks	12.0	0.4
1909	Nichols' Snow White Samp	13.4	0.3
1909	Post Toasties	11.7	0.3
1909	Quaker Best Yellow Corn Meal	12.3	0.8
1917	Quaker Corn Puffs	12.0	0.3
1909	Quaker Toasted Corn Flakes	11.6	0.4
1909	Ralston Hominy Grits	11.3	2.9
1909	Street's Perfection Hominy	12.4	1.3
1917	Sunbeam Pearl Hominy	14.3	0.6
1917	Washington Corn Crisps	12.1	0.2
	Oat Preparations.		
1917	Bestovotes	11.0	6.6
1917	Bufceco Rolled Oats	11.1	6.8
1909	Grandmother's Crushed Oats	10.7	6.5
1909	Health Brand White Oats	10.9	7.8
1917	Hecker's Cream Oat Meal	11.5	5.6
1909	Hornby's Steam Cooked Oat Meal	10.6	6.7
1917	Keen & Robinson's Granulated Scotch Oatmeal	10.4	9.1
1909	Leggett's Premier 15 Minute Oat Flakes	11.3	5.4
1917	McCann's Irish Oat Meal	9.2	8.7
1909	Mother's Crushed Oats	10.9	6.1
1909	Paw-Nee Rolled Oats	10.8	6.7
1917	Purity Rolled Oats	13.5	6.1
1909	Quaker Oats	10.8	6.0
1917	Robinson's Patent Groats	8.4	8.6
1917	Scott's Porage Oats	10.1	9.6
1909	Sovereign 15 Minute Oat Flakes	10.8	5.8
1909	White Rose Rolled Oats	10.3	8.0
	Rice Preparations.		
1915	Comet Cereal	11.3	0.3
1909	Cook's Flaked Rice	12.6	0.1
1909	Cook's Malto Rice	11.3	0.2
1915	Kellogg's Toasted Rice Biscuit	5.0	0.3

BREAKFAST FOODS.

Pounds per hundred.						Cost in 1917.			
Crude fiber.	Protein (N×6.25).	Ash.	Carbohydrates other than fiber.	Starch.	Calories per ¼ lb.	Per package.	Per pound.	Per 100 calories.	Net weight of package.
						cts.	cts.	cts.	ozs.
0.9	11.5	1.2	75.2	62.7	410	......	......	......	32*
0.3	9.5	1.0	76.2	69.2	401	......	......	......	18*
0.1	6.9	1.5	79.9	60.2	401	......	......	......	10*
0.2	6.6	2.2	78.6	61.3	393	......	......	......	10*
0.2	8.0	0.4	77.1	75.7	399	......	......	......	74*
0.5	9.8	0.3	77.3	71.2	402	18	12	0.75	24
0.2	8.0	0.4	79.8	74.4	404	......	......	......	30*
5.0	13.3	3.7	66.1	37.4	398	25	10	0.63	40
0.3	8.5	0.9	82.3	64.7	418	10	18	1.08	9
0.2	6.4	2.7	78.8	55.5	392	11	22	1.40	8
0.1	7.4	2.2	77.9	66.3	394	......	......	......	8*
0.5	7.8	0.3	77.7	78.2	394	......	......	......	32*
0.2	6.6	1.8	79.4	53.9	396	11	22	1.39	8
0.2	7.5	0.5	78.7	75.7	402	12	8	0.50	24
0.1	8.7	0.4	78.5	43.2	402	14	37.5	2.33	6
0.0	6.8	1.3	79.9	68.3	398	7	14	0.88	8
0.4	9.0	1.0	75.4	70.9	416	......	......	......	30*
0.1	7.9	0.4	77.9	74.5	406	......	......	......	31*
0.3	9.4	0.4	75.0	70.8	392	43	9.5	0.54	74
0.2	7.8	2.9	76.8	59.5	389	10	16	1.03	10
1.0	16.2	2.1	63.1	55.1	430	17	10	0.58	24
1.0	15.1	2.0	64.0	55.6	432	10	8	0.46	20
0.6	14.9	1.9	65.4	59.1	434	......	......	......	28*
1.0	13.8	2.0	64.5	58.8	438	....	....	....	32*
0.9	15.6	1.8	64.6	56.7	424	10	8	0.48	20
0.8	16.1	1.7	64.1	59.2	436	14	11	0.63	20
0.8	13.7	1.9	64.1	57.0	449	110	22	1.22	80
0.6	17.2	1.8	63.7	56.6	425	15	12	0.71	20
0.3	15.1	1.8	64.9	56.8	455	95	19	1.04	80
0.9	15.6	1.6	64.9	58.4	431	9	7	0.42	20*
0.8	15.8	1.9	64.0	59.7	434	......	......	......	25*
1.0	16.3	2.0	61.1	57.4	417	10	8	0.48	20
0.9	15.9	1.9	64.5	56.7	429	10	8	0.47	20
0.7	12.8	1.8	67.7	60.5	456	50	50	2.74	16
0.4	13.3	1.7	64.9	56.8	456	25	13.5	0.74	30
0.9	16.5	2.0	64.0	58.0	428	....	....	....	34*
0.7	14.3	1.9	64.8	59.0	432	....	....	....	30*
0.2	7.2	0.3	80.7	....	405	....	....	....	16*
0.2	7.8	0.4	78.9	78.2	397	....	....	....	15*
0.1	7.6	0.6	80.2	74.1	403	....	....	....	17*
0.2	10.1	3.7	80.7	57.4	418	15	40	2.39	6

* Net weight of package at date specified in the first column.

TABLE I.—CEREAL

Date of Analysis.	Brand.	Water.	Fat.
	Rice Preparations—Continued.		
1915	Kellogg's Toasted Rice Flakes	4.7	0.4
1909	Milk Rice	12.3	0.2
1909	Quaker Puffed Rice	12.2	0.2
	Rye Preparation.		
1915	Kellogg's Toasted Rye Flakes	8.1	1.5
	Wheat Preparations.		
1917	Alber's Wheat Flakes Mush	11.5	2.1
1913	Brusson Farine au Gluten	10.9	0.6
1910	Brusson Gluten Semolina	9.7	0.5
1915	Cero-Vita	4.6	0.7
1917	Cinnamon Rusks	9.9	7.2
1909	Cream of Wheat	13.1	0.9
1913	Cresco Grits	11.1	1.4
1914	Crystal Wheat	9.5	2.0
1914	Dieto Rusks	6.4	9.1
1909	Force	10.7	1.1
1917	F S Farina (Quaker Farina)	13.7	0.9
1909	Grandmother's A. & P. Farina	12.9	0.6
1911	Granola	6.1	0.8
1914	Granose Biscuit	11.3	1.6
1915	Granose Flakes	6.0	3.9
1909	Grape Nuts	10.3	0.6
1909	Hecker's Farina	12.7	0.7
1909	Holland Rusk	11.0	5.1
1914	Hoyt's Gum Gluten Breakfast Food	6.5	0.9
1914	Hoyt's Gum Gluten Granules	6.6	0.7
1913	Jireh Frumenty	6.2	1.7
1913	Jireh Whole Wheat Farina	6.2	2.3
1912	Kellogg's Breakfast Toast	7.7	1.9
1917	Kellogg's Krumbles	10.0	1.2
1915	Kellogg's Toasted Wheat Biscuit	5.8	1.4
1915	Kellogg's Toasted Wheat Flakes	5.2	1.1
1915	Kellogg's Zwieback	6.2	1.6
1909	Leggett's Premier Farina	14.1	0.9
1909	Malt Breakfast Food	9.6	1.5
1914	Manana Gluten Breakfast Food	7.6	2.0
1909	Mapl-Flake	10.8	1.2
1917	Mother's Wheat Hearts	13.5	1.1
1909	Pettijohn's Breakfast Food	10.3	2.0
1909	Pillsbury's Best Cereal	11.3	0.7
1909	Quaker Cracked Wheat	11.7	2.3
1917	Quaker Puffed Wheat	11.5	1.8
1909	Quaker Wheat Berries	9.8	2.0
1909	Ralston Health Food	12.4	1.7
1917	Ralston Wheat Food	11.9	1.8

Breakfast Foods—*Continued.*

Pounds per hundred.					Calories per ¼ lb.	Cost in 1917.			
Crude fiber.	Protein (N x 6.25).	Ash.	Carbohydrates other than fiber.	Starch.		Per package.	Per pound.	Per 100 calories.	Net weight of package.
						cts.	cts.	cts.	ozs.
0.2	10.0	3.4	81.3	55.7	422	15	30	1.78	8
0.2	6.9	3.2	77.2	62.6	387	....	....	....	8*
0.1	7.6	0.4	79.5	61.8	400	14	56	3.50	4
0.6	11.4	2.2	76.2	45.7	416	15	30	1.80	8
0.3	11.1	1.6	73.4	59.2	408	15	10	0.61	24
0.2	33.9	0.6	53.8	48.8	407	....	....	....	9*
0.3	17.2	0.7	71.6	64.9	411	....	....	....	30*
0.3	8.9	3.5	82.0	52.3	423	15	30	1.77	8
0.2	10.3	0.7	71.7	49.5	449	18	21	1.17	14
0.2	11.5	0.6	73.7	71.1	399	22	12.5	0.78	28
0.5	17.8	0.6	68.6	54.1	409	....	....	....	32*
1.7	11.3	1.9	73.6	....	408	20	14.5	0.89	22
1.0	15.9	1.5	66.1	52.1	469	60	76	4.05	13
1.1	10.6	2.8	73.7	59.9	397	11	17.5	1.10	10
0.2	10.2	0.4	74.6	63.9	397	10	11	0.69	14.5
0.1	10.8	0.6	75.0	71.7	398	....	....	....	16*
0.6	13.9	2.3	76.3	45.2	421	20	24.5	1.46	13
1.8	10.3	3.9	71.1	....	389	15	60	3.86	4
0.5	10.3	3.9	75.4	55.5	432	15	40	2.31	6
1.5	11.5	1.9	74.2	36.3	398	13	16	1.01	13
0.1	10.0	0.6	75.9	71.2	400	14	14	0.88	16
0.1	12.1	1.3	70.4	55.8	430	11	29	1.69	6
0.3	45.4	0.6	46.3	39.2	429	35	35	2.04	16
0.5	42.7	0.7	48.8	41.9	425	35	35	2.06	16
1.1	12.3	1.4	77.3	65.4	427	....	....	....	24*
2.2	12.9	1.8	74.6	59.5	424	....	....	....	24*
0.3	13.6	1.6	74.9	57.4	424	20	35.5	2.09	9
1.9	12.0	2.6	72.3	59.0	398	8	16	1.01	8
1.5	14.2	2.4	74.7	45.8	421	12	19	1.13	10
1.2	9.3	2.7	80.5	57.0	422	15	30	1.78	8
0.2	14.3	1.6	76.1	60.4	384	25	28.5	1.86	14
0.1	11.1	0.5	73.3	71.0	395	....	....	....	16*
1.0	13.8	1.4	72.7	53.5	411	22	12.5	0.76	28
1.7	42.6	2.5	43.6	29.9	415	25	40	2.41	10
1.2	9.3	2.8	74.7	58.3	396	....	....	....	11*
0.2	10.7	0.4	74.1	65.0	399	15	8	0.50	29
2.0	9.1	1.7	74.9	64.0	405	18	12	0.74	24
0.1	11.5	0.5	75.9	74.1	407	....	....	....	32*
1.7	9.3	1.7	73.3	63.6	401	25	15.5	0.97	26
1.6	13.1	1.8	70.2	29.5	399	15	60	3.76	4
1.2	14.0	1.4	71.6	57.1	412	....	....	....	8*
1.1	11.9	1.4	71.5	64.4	399	....	....	....	29*
0.8	11.3	1.1	73.1	62.8	404	22	15	0.94	24

* Net weight of package at date specified in the first column.

TABLE I.—CEREAL

Date of Analysis.	Brand.	Water.	Fat.
	Wheat Preparations—Continued.		
1915	Sanitas Granuto	4.9	1.7
1909	Saxon Wheat Food	9.8	1.7
1909	Shredded Wheat Biscuit	8.5	1.4
1909	Street's Perfection Farina	13.1	1.1
1909	Triscuit	10.3	1.4
1917	Vitos	11.6	1.0
1909	Wheatena	10.4	2.8
1909	Wheatlet	12.2	1.6
1909	Zest	10.7	1.2
	Wheat Bran.		
1914	Ballard's Obelisk Sanitary Edible Bran	11.5	5.4
1917	Culp's Capitol Health Bran	11.2	4.3
1914	Health Food Co.'s Wheat Bran	11.6	4.1
1914	Jireh Wheat Bran	11.1	4.8
1914	Johnson's Educator Wheat Bran	11.6	4.7
1914	Kellogg's Sterilized Wheat Bran	9.6	5.2
	Wheat Bran Biscuit and other Laxative Preparations.		
1914	Bran Biskue	8.5	13.1
1917	Bran-eata Biscuit	9.8	0.9
1917	Bran Zos	11.9	2.5
1914	Brose Good Health Breakfast Food	10.1	4.3
1917	Cerag	9.2	0.9
1910	Cerena	7.2	11.4
1914	Christian's Laxative Bread	9.9	1.4
1909	Christian's Laxative Cereal Flakes	13.0	1.4
1914	Colax	13.1	0.8
1914	Dietetic Bran Biscuit	9.3	5.0
1914	Educator Bran Cookies	7.1	14.5
1914	Educator Bran Meal	11.8	2.8
1915	F. B. A. Laxative Health Biscuit	11.1	1.7
1917	Fruit Nut Cereal	7.3	1.2
1914	Good Health Biscuit (Kellogg)	10.9	1.2
1914	Health Food Wafers	9.7	7.9
1917	India (Digestive) Biscuit	8.7	2.2
1915	Laxa	6.6	2.8
1914	Laxative Biscuit (Kellogg)	9.4	10.8
1914	Mansfield's Agar Agar Wafers	7.9	12.0
1914	Oval Digestive Biscuit (H. & P.)	8.8	16.3
1915	Uncle Sam Health Food	6.3	24.4
1917	Zim	13.2	1.7
	Miscellaneous Preparations.		
1914	Dieto Nut Cereal	5.0	18.4
1914	Dieto Wheat and Barley Cereal	6.8	2.2
1906	Jireh Wheat Nuts	7.6	15.6

BREAKFAST FOODS—*Continued.*

Pounds per hundred.					Calories per ¼ lb.	Cost in 1917.			Net weight of package.
Crude fiber.	Protein (N x 6.25).	Ash.	Carbohydrates other than fiber.	Starch.		Per package.	Per pound.	Per 100 calories.	
						cts.	cts.	cts.	ozs.
0.4	10.1	1.3	81.6	43.4	437	20	23	1.32	14
0.5	12.8	0.8	74.4	69.6	416	22	13.5	0.81	26
2.6	11.0	1.5	75.0	63.1	408	12	16	0.98	12
0.1	10.3	0.5	74.9	71.1	401	....	....	....	16*
1.7	11.0	1.7	73.9	60.8	403	12	20	1.24	9.5
0.2	11.1	0.5	75.6	68.7	417	15	8.5	0.51	28
0.6	11.3	0.7	74.2	69.8	420	18	15	0.89	19
0.3	12.8	0.8	72.3	66.2	406	....	....	....	28*
1.2	9.0	2.6	75.3	60.1	398	....	....	....	11.5*
5.6	17.3	4.5	55.7	....	390	25	9.5	0.61	42
8.2	13.4	5.3	57.6	....	369	15	8.5	0.58	28
8.2	14.3	5.6	56.2	....	364	10	12.5	0.86	13
6.3	16.8	4.3	56.7	....	385	10	6.5	0.42	24
7.8	15.4	6.1	54.4	....	368	15	12	0.82	20
8.5	16.3	6.0	54.4	....	377	25	23.5	1.56	17
2.2	12.1	3.1	61.0	....	469	15	15	0.80	16
3.6	9.1	4.4	72.2	21.0	381	15	24	1.57	10
3.8	13.2	3.0	65.6	46.2	386	15	12	0.78	20
3.1	14.4	2.6	65.5	....	410	20	20	1.22	16
2.0	11.3	3.6	73.0	20.8	....	15	24	....	10
2.4	27.8	4.9	46.3	25.1	456	25	25	1.37	16*
1.3	10.0	2.8	74.6	....	401	25	30	1.87	13*
1.0	10.4	1.7	72.5	61.2	393	....	....	....	21*
0.1	1.1	2.1	82.8	....	....	100	26.7	....	6
1.7	9.9	5.0	69.1	....	413	25	38	2.30	10.5
1.5	8.9	3.3	64.7	....	486	25	50	2.57	8
3.8	12.3	2.9	66.4	....	389	20	7.5	0.48	42
0.7	6.1	3.1	77.3	....	398	....	....	....	....
2.4	13.5	3.2	72.4	36.5	405	15	21	1.30	11
1.5	7.7	4.2	74.5	....	389	15	40	2.57	6
1.4	10.0	5.3	65.7	....	427	15	17.5	1.03	13.5
5.2	12.8	5.0	66.1	....	383	25	33	2.15	12
6.6	12.4	5.0	66.6	....	....	50	106	....	7.5
2.4	16.7	3.0	57.7	....	451	....	....	....	3
0.8	7.1	2.3	69.9	....	475	23	73.5	3.87	5
0.5	7.8	2.1	64.5	....	499	15	30	1.50	8
4.0	21.3	3.1	40.9	....	538	28	25	1.16	18
1.5	7.4	2.0	74.2	6.2	391	15	20	1.28	9
1.2	21.6	2.0	51.8	39.5	525	30	34	1.62	14
2.0	11.6	1.7	75.7	61.4	410	....	....	....	36*
1.0	19.0	2.3	54.5	50.1	496	30	30	1.51	16

* Net weight of package at date specified in the first column.

TABLE I.—CEREAL

Date of Analysis.	Brand.	Water.	Fat.
	Miscellaneous Preparations—Continued.		
1917	Malabar Manoca	13.3	0.1
1917	Post Tavern Porridge	12.7	0.8
1913	Post Tavern Special	9.9	1.1
1917	Sea Moss Farina	15.6	0.3
1917	Sunbeam Tapioca	13.5	0.1
1913	Trix	6.2	0.2

It appears from the facts given in this bulletin that cereal breakfast foods can be bought uncooked, partially cooked, or ready to serve. The difference in prices between the three kinds is in some cases very great, but in others so little that their extra cost probably is not more than the cost of fuel which would be used for cooking the raw meals.

The greater popularity of wheat foods is indicated by the fact that 48 wheat foods, besides 29 wheat laxative preparations have been found in one market, 18 of corn, 17 of oats, 7 of rice, 2 of barley and 1 of rye.

Attention is called to the relative food value and cost of these preparations and the more general use of oat and corn foods is suggested.

OATMEAL and "ROLLED OATS," sold in bulk or in various package forms, are the most nutritious and, considering their food value, the cheapest of the cereals. The uncooked oat preparations sell generally now for from 7 to 12 cents a pound. They contain from 1½ to 2 times as much protein, 3.9 times as much fat and 120 more calories—or heat producers—per pound than other commonly used cereals, and the ratio of protein to non-protein calories is what is required in a complete ration.

WHEAT, CRACKED or FLAKED, is, next to oats, the richest in protein, but one of the most expensive cereal foods. A very large number of preparations made from wheat are on the mar-

BREAKFAST FOODS—*Concluded.*

Pounds per hundred.					Calories per ¼ lb.	Cost in 1917.			
Crude fiber.	Protein (N x 6.25).	Ash.	Carbohydrates other than fiber.	Starch.		Per package.	Per pound.	Per 100 calories.	Net weight of package.
						cts.	cts.	cts.	ozs.
0.6	0.6	1.3	84.1	....	388	22	22	1.42	16
0.2	10.3	1.5	74.5	67.2	396	18	10	0.63	28
0.3	10.9	0.9	76.9	69.3	413	14	8	0.48	28
1.5	9.1	13.6	59.9	....	....	30	120	....	4
0.1	0.6	0.2	85.5	....	396	20	20	1.26	16
0.3	14.5	1.5	77.3	48.6	422	15	16	0.95	15

* Net weight of package at date specified in the first column.

ket, none of them probably superior, considering both cost and composition, to plain cracked wheat (easily made at home by crushing whole wheat very coarse in a coffee mill).

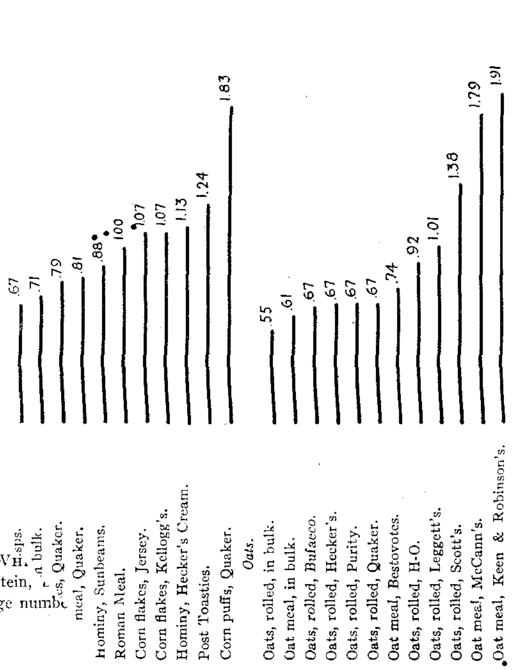
CORN PRODUCTS, such as MEAL, FLAKES, HOMINY and SAMP, all have about the same composition and nutritive value. They are inferior in nutritive value to either wheat or oats, while their average cost at present is greater than that of oat products.

RICE GRAIN, RICE FLAKES and PUFFED RICE, have less protein and fat than any other cereal, have about the same heat value as corn or wheat products and at present are relatively very expensive.

It is clear that oats used as a breakfast cereal, not only conserves wheat, but furnishes a richer food at a lower price. The other cereals, corn and rice, one cheap, the other expensive, have about the same fuel value as wheat, but generally contain less protein or flesh-forming material. Wheat is, however, the most generally satisfactory cereal food. Some people cannot constantly use corn meal as a breakfast food without digestive trouble, but occasional use of it furnishes acceptable variety. Oats are much more generally satisfactory for constant daily use.

All the grain preparations require long cooking; three hours in a double boiler is not too much, and this will naturally be done at any time in the day when the stove is being used for other purposes as well.

Relative Cost of Breakfast Foods per Serving (in cents).



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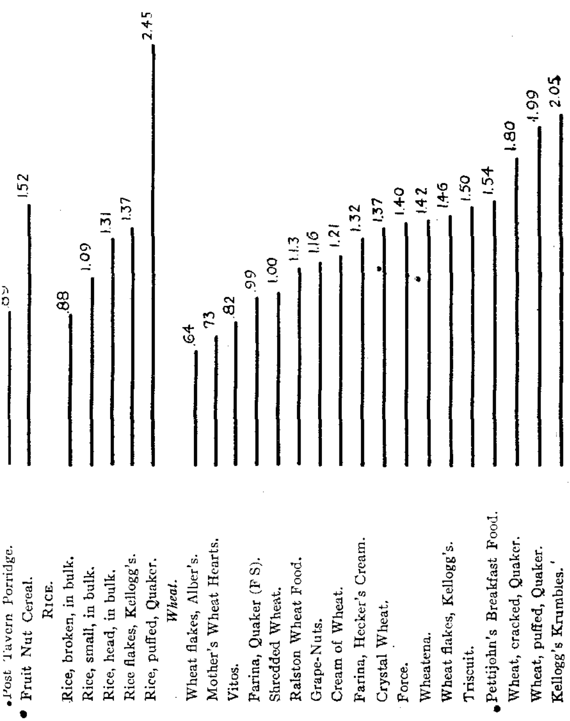
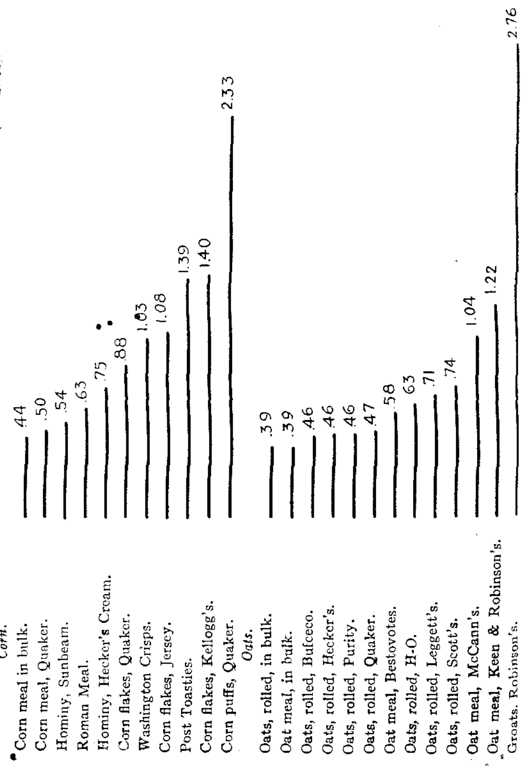
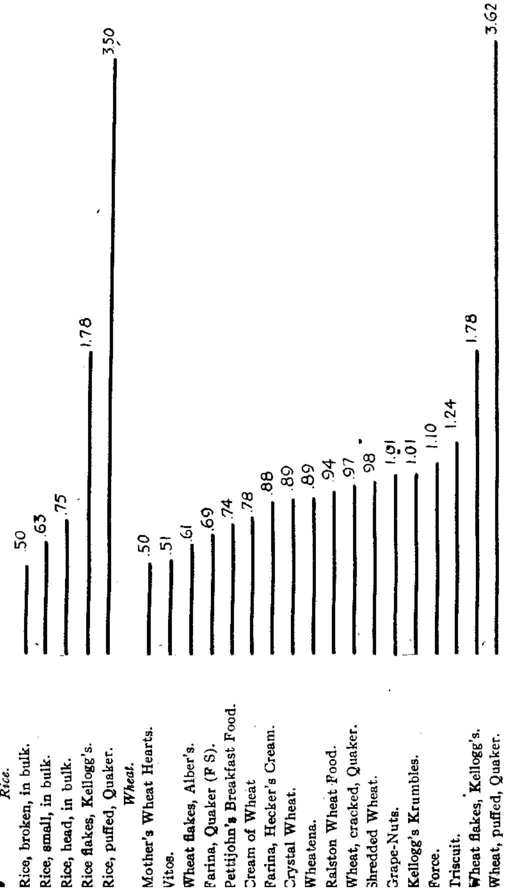

Post Tavern Porridge.
Fruit Nut Cereal. 1.52
RICE.
Rice, broken, in bulk. .88
Rice, small, in bulk. 1.09
Rice, head, in bulk. 1.31
Rice flakes, Kellogg's. 1.37
Rice, puffed, Quaker. 2.45
Wheat.
Wheat flakes, Alber's. .64
Mother's Wheat Hearts. .73
Vitos. .82
Farina, Quaker (F S). .99
Shredded Wheat. 1.00
Ralston Wheat Food. 1.13
Grape-Nuts. 1.16
Cream of Wheat. 1.21
Farina, Hecker's Cream. 1.32
Crystal Wheat. 1.37
Force. 1.40
Wheatena. 1.42
Wheat flakes, Kellogg's. 1.46
Triscuit. 1.50
Pettijohn's Breakfast Food. 1.54
Wheat, cracked, Quaker. 1.80
Wheat, puffed, Quaker. 1.99
Kellogg's Krumbles. 2.05

Relative Cost of Breakfast Foods per 100 Calories (in cents).



RELATIVE COST OF BREAKFAST FOODS PER 100 CALORIES (IN CENTS)—*Concluded.*



Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 198 NOVEMBER, 1917

Domestic Supplies of Potash

By E. H. JENKINS

CONTENTS

	Page
Canada Hardwood Ashes	47
Ashes from Household Fire	47
Ashes from Corn Cobs	49
Ashes from Brush Heaps	49
Salt Marsh and River Meadow Hay as a Source of Potash	49
Ashes from Brick Kilns	50
Ashes from Witch Hazel Stills	51
Ashes from Brass Mills	51
Ashes of Seawoods	52
Potash in Farm Manure	52

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to others as far as the editions permit.

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Domestic Supplies of Potash.

There is practically no commercial supply of potash salts which can be used to profit by farmers, and probably there will be no adequate supply while war lasts. A brief notice of the domestic supply, chiefly of various kinds of ashes, may, therefore, be helpful.

"CANADA HARDWOOD ASHES."

The following statement shows the average composition of the so-called Canada Hardwood Ashes offered in Connecticut during the periods named, as determined by our analyses:

		Contained in the ashes, per cent.			
Period	No. of analyses	Water-soluble potash	Phosphoric acid	Lime	Valuation per ton*
1903 to 1906	72	4.74	1.35	30.00	$10.65
1907 to 1910	49	3.78	1.42	27.31	8.99
1911 to 1917	23	2.77	1.15	23.80	6.96

The figures show that Canada Ashes have decreased steadily in quality and value since 1900.

The average shipment of Canada Ashes at present has only two-thirds the value of the average shipment ten years ago. Many shipments are even less valuable and are neither hardwood ashes, nor even wood ashes in any fair meaning of the term. The reasons for this are variously given, but the fact, which alone concerns us, is indisputable. Unless buyers make a hard and fast agreement to pay on the basis of water-soluble potash, with a specified rebate for any deficiency, and have their shipments carefully sampled and analyzed, there can be no certainty of economy in their purchase.

ASHES FROM HOUSEHOLD FIRES.

The average of all our analyses of household wood ashes produced in this state shows 5.99 per cent. of water-soluble potash, 2.68 per cent. of phosphoric acid and 33.58 per cent. of lime; the extremes of potash being 2.93 and 7.51 per cent. The wide differences in composition are due partly to differences in the ash-content of the wood, partly also to the heat of burning. If the

* Based on values which obtained a few years ago; viz., potash as carbonate 7.7 cents and phosphoric acid 3½ cents per pound; lime 40 cents per 100 pounds.

heat is intense and long continued, especially if sand or earth adheres to the wood, more or less potash combines with silica and becomes insoluble.

A bushel of dry ashes from the stove or fireplace weighs about 48 pounds and may contain about 2.9 pounds of potash, 1¼ pounds of phosphoric acid and 16 pounds of lime, which, with the present prices of potash, would be worth 80 cents or more.

Seventeen hundred pounds, or about 35½ bushels, contain as much soluble potash (50 pounds) as 100 pounds of muriate of potash and in more desirable form, besides 45 pounds of phosphoric acid and 570 pounds of lime, in form of fine carbonate. No better fertilizer for clover or other legumes can be suggested.

Of course, these figures are only approximate, but show the wisdom of carefully collecting and saving in a dry place *all* the wood ashes from stoves and fireplaces, for use in garden and field. They are too often wasted by mixing with coal ashes, which are comparatively worthless, or thrown with wastes to be carted off to a dump.

Too much cannot be said of the value of the "open fire" in the house, whether in city or country. Aside from its value for heating and ventilation, it should be more used than it is as a "destructor" for many kinds of wastes, recovering from them the most of what has any value. A hot fire will dry and consume, with no annoyance, much of the kitchen waste of the day, or if the waste is buried at night in the hot ashes, it will dry and be consumed in the next fire. Besides the satisfaction of not burdening others with one's own waste, there is satisfaction in the saving of some valuable material which would otherwise be lost. While the amount of potash in the wastes themselves is relatively very small, the per cent. of potash in *their ashes* is, in some cases, surprisingly large. For example, recent tests at this station show the following percentages of potash and phosphoric acid in the *ashes* of certain common vegetable wastes:

	Potash	Phosphoric acid
Apple parings	11.74	3.08
Banana stalks, yellow	49.40	2.34
" " red	46.64	3.04
" skins	41.76	3.25
Grape fruit skins	30.64	3.58
Lemon skins	31.00	6.30
Orange skins	27.04	2.90

	Potash	Phosphoric acid
Peanut shells	6.45	1.23
Potato peelings	27.54	5.18
Corn cobs	17.25	3.14
Cigar ashes	16.81	2.57

There are other wastes which have very little potash in their ashes. Among these are:

	Potash	Phosphoric acid	Lime
Egg shells	0.29	0.43	52.12
Dry leaves	0.51	0.38	1.58

The Ashes of Corn Cobs.

The percentage of potash in corn cobs is quite small, about 0.45 per cent., but the ashes of corn cobs which are sometimes available where corn is shelled on the farm are a source of potash worth considering. An analysis made here some time ago showed:

Water-soluble potash	21.13%
Phosphoric acid	4.01

Ashes from Brush Heaps.

When land is cleared for cultivation or pasture, or extensive orchard pruning and cutting of worthless trees has been done, the ashes from the brush heaps will probably have nearly the same composition as that of those produced in witch-hazel factories. (See below.) Canadian analyses show 10.3 per cent. of potash in the ashes of blackberry canes, 13 per cent. in those of gooseberries and 7.9 in those of raspberries. The effect of these ashes is often seen for years in increased production on spots where brush was burned.

Salt Marsh and River Meadow Hay as a Source of Potash.

While no one would think of burning salt marsh hay for the potash in it, we call attention here to its composition, to show that the use of the herbage from salt marshes, either for feed or for litter, brings very considerable amounts of potash, as well as other plant food, to the land from the sea. Analyses made here some years ago showed that the following quantities (expressed in pounds) of plant food were carried to the farm from the salt marsh per ton of hay of the kinds named:

	Nitrogen	Phosphoric acid	Potash
Black grass (*Juncus gerardi*)	23.8	5.0	42.0
Salt grass (*Spartina juncea*)	17.4	5.4	14.0
Three-Square (*Scirpus americanus*)	23.8	5.0	30.2
Creek sedge (*Spartina glabra*)	21.8	7.4	21.2

Hay from these grasses carries besides from 12 to 90 pounds of salt, or an average of 54 pounds per ton.

Small fruits, such as raspberries and currants, which are abundantly mulched with marsh grasses, scarcely need other fertilizers, and the coarser grasses should be used abundantly as litter and composted with manure.

River meadows, where the tall "bent" grasses grow every year with no fertilizer other than that supplied in the spring freshets, yield about as much nitrogen and phosphoric acid, but less potash than the marsh grasses. The following figures from one of our previous reports show this.

In one ton of hay of the grasses named are the following number of pounds of the three plant foods under discussion:

	Nitrogen	Phosphoric acid	Potash
Black bent (*Panicum virgatum*)	29	7	10
Blue bent (*Andropogon provincialis*)	21	6	11
Indian grass (*Sorghastrum nutans*)	20	10	19
Poverty grass (*Andropogon scoparius*)	11	5	11

Ashes From Brick-Kilns.

In normal years about two hundred million brick are made in Connecticut, but in 1916 and 1917 probably not more than half or two-thirds of that number yearly, because of bad weather and scarcity of labor. From 200 to 250 cords of woods are used in burning a million brick, so that this year's consumption of wood in Connecticut brick-kilns will be at least 22,500 cords. If the wood weighs 3,250 pounds per cord and contains 0.75 per cent. of ash, with 6 per cent. of potash in the ashes, the total amount of potash contained in the wood burned would be 16.45 tons; as much as is contained in 32.9 tons of muriate of potash.

The actual yield of water-soluble potash from the ashes which can be raked from the kilns after firing is, however, quite disappointing. This is explained by the facts that a part of the ashes is carried away by the strong draft and scattered through the kiln or into the air and that the intense heat fuses the carbonate of potash with the silicate in the clay and makes much of it insoluble in water and a part insoluble even in acids.

Six analyses of brick-kiln ashes gave us an average of 1.58 per cent. of potash and 1.70 of phosphoric acid.

A careful test which we made at the brick-kilns of Stiles & Son, at North Haven, with the kind co-operation of the owners, gave the following result: The kiln had 26 arches and contained about 780,000 brick. Three of the arches were raked clean. The screened ashes weighed 388 pounds, or 3,362 pounds for the kiln. The amount of wood burned in the kiln was, approximately, 182 cords, so that a cord of wood left 18.5 pounds of ashes in the arch. The ashes contained

	Per cent.
Total acid-soluble potash	2.44
of which, water-soluble	1.30
Lime	37.42
Magnesia	3.84
Phosphoric acid	1.91
Moisture	0.16

A cord of wood such as is burned there is stated to weigh about 3,250 lbs. The amount of pure ash in it will not be far from 24.4 lbs., containing perhaps 1.5 lbs. of potash. But apparently, there was recovered in the kiln ashes only 0.45 lbs., or less than one-third, in acid-soluble form.

Ashes From Factories.

Witch-Hazel Stills. There are five or more factories in this state where witch-hazel, or black birch, brush is distilled. The brush is then burned to make steam. When coal is not used with the brush, the ashes are of excellent quality, as appears in the following analysis, made some time ago:

	Per cent.
Total potash	5.09
Water-soluble potash	4.61
Phosphoric acid	4.52
Lime	37.75
Magnesia	4.68

An analysis of the ashes, recently made, showed 4.47 per cent. of water-soluble potash and 4.95 of phosphoric acid.

Brass Mills. Four analyses of the ashes of wood used in muffles at the brass mills of this state contained the following percentages:

	Average	Extremes
Water-soluble potash	4.35	2.9— 6.1
Phosphoric acid	2.64	1.9— 3.4
Lime	36.00	25.4—47.4

Smoke-House. Corn cobs or hickory wood have been most commonly used on farms for smoking meats. The average of three analyses is

	Per cent.
Total potash	7.72
Phosphoric acid	1.48
Lime	41.78

THE ASHES OF SEAWEEDS.

The burning of kelp and other seaweeds, for the extraction of potash, iodine and bromine, has long been practiced on the coasts of the British Isles. It has not, to our knowledge, been done to any extent in this country.

The analyses of seaweeds in our Bulletin 194 show that the *pure* ash of kelp and rockweed may contain not far from 9 per cent. of potash, and that of the eel-grass only 3 per cent.

For farm use there is probably no economy in drying and burning seaweeds for the sake of the potash. It will probably pay better to haul wet rockweed or kelp directly to the land, and eel-grass, after draining and drying, to the pig-pen or cow stables for litter, as suggested in the Bulletin.

THE POTASH IN FARM MANURE.

Farm manure is commonly regarded as distinctly a nitrogenous manure, for its nitrogen content proclaims itself in various ways. But manure contains as much potash as nitrogen and often more, and more than one-half of this potash is contained in the urine. The same is true of the nitrogen. Yet on many farms the liquid manure is allowed to run to waste, or at any rate no great pains are taken to absorb and hold it. More attention is paid to the solid than to the liquid part of the manure.

There would be less loss of fertilizer value if all of the urine were saved and litter and dung thrown away than if all the solids of the manure were saved and all the liquid wasted.

The value of manure depends both on the character of the feed and on the meat or milk production of the animals.

A ton of farm manure from cows, hogs or steers will contain on the average from 9½ to 13 pounds of potash. It may contain considerably more if pains are taken to prevent any loss of liquid.

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ALENDAR

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BULLETIN 19

G. P. CLINTON, Botanist

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BULLETIN 19

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DIRECTIONS FOR PREPARING INSECTICIDES AND FUNGICIDES.

FORMULAS FOR INSECTICIDES.

LEAD ARSENATE.

3 lbs. (Paste) or 1½ lbs. (Dry) Lead Arsenate.
50 gals. Water.

Spray upon foliage to kill all chewing insects. May be used with Bordeaux or with lime-sulphur mixture.

PARIS GREEN.

1 lb. Paris Green. 3 lbs. Lime.
100 gals. Water.

Spray upon foliage to kill potato beetle, elm leaf beetle, and all chewing insects. Commonly used with Bordeaux mixture.

POISONED BRAN MASH.

5 lbs. Wheat Bran. 4 oz. White Arsenic or Paris Green.
1 pt. Cheap Molasses. 1 Lemon. 7 pts. Water.

Scatter around in field to kill cut-worms, army worms and grasshoppers.

HELLEBORE.

Dust on the plants, or mix with water, 1 oz. in 2 gals. and spray. For currant-worm and other saw-fly larvae.

COMMERCIAL LIME-SULPHUR.

Winter Spray.

1 part lime and sulphur. 9 parts water.

Summer Spray.

1¼ to 1½ parts lime and sulphur. 45 to 50 parts water.

Use winter spray for San José scale and peach leaf curl; summer spray for fungi, to which, as needed, add lead arsenate to kill chewing insects.

NICOTINE SOLUTION.

½ pint in 50 gals. Water.

Several solutions are now sold containing 40% or more of nicot[ine]. Excellent for killing aphids and other sucking insects. Add soap f[or] spreader.

KEROSENE EMULSION.

2 gals. Kerosene. ½ lb. common soap.
1 gal. Water.

Dissolve the soap in hot water, add the kerosene, and churn toge[ther] with pump until a white creamy mass is formed which thickens on cool[ing]. Dilute nine times before using.

MISCIBLE OILS.

Several miscible oils are on the market, such as "Scalecide" "Jarvis Compound." Are used to kill San José Scale, especially on apple trees. Should be mixed 1 part in 15 parts water.

COMMON SOAP.

1 lb in 8 gals. Water.

Spray upon foliage to kill red spider, aphids and other sucking ins[ects].

CARBON DISULPHIDE.

To kill insects infesting stored grain, in tight bins, use 1 lb. for a[bout] 40 bushels of grain. Expose for about 36 hours.

NAPHTHALENE.

Used in the form of moth-balls and "flakes" to keep clothes m[oths] out of clothing. "Flakes" scattered around the borders of floors[,] shelves will drive away ants.

FORMALIN FLY POISON.

1 tablespoonful *Commercial Formalin.*
½ cup Sweet Milk. ½ cup Water.

Mix together and expose in a shallow plate with a slice of bread in it. lies will drink the liquid, especially if no other moisture is accessible, nd be killed.

HYDROCYANIC ACID GAS.

1 oz. Potassium Cyanide.
2 oz. Sulphuric Acid. 4 oz. Water.
For each 100 cu. ft. space.

For dormant stock place the acid and water in an earthen jar in the ouse, drop in the cyanide and close the house at once for half an hour. entilate for ten minutes before entering. In greenhouse use 1 oz. of yanide for each 1000 cu. ft. of space.

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Summer Spray.
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BORDEAUX MIXTURE.

4 lbs. Copper Sulphate.
4 lbs. *Fresh Lime. 40 to 50 gals. Water.*

Dissolve the copper sulphate in hot water or from a coarse bag suspended in cold water; slake the lime separately and strain. Dilute the tter to about 20 gals., into which pour the copper sulphate, diluted to or fifty gallons; or dilute each to 25 gals., and pour together into barrel. *Stock solutions* of the copper sulphate and lime, rate 1 lb. to 1 gal. water, can be made separately and used as needed.

SELF-BOILED LIME-SULPHUR.

8 lbs. Fresh Whitewash Lime.
8 lbs. Fine Sulphur. 45 to 50 gals. Water.

Start the lime slaking, sift and *thoroughly stir in the sulphur*, using just enough water to prevent burning and allow to boil from heat of lime for fifteen minutes. Then dilute and apply.

FORMALIN.

A. 1 pt. (1 lb.) Formalin in 50 gals. water, for sprinkling grain to kill smut.

B. 1 pt. Formalin in 30 gals. water, for soaking tubers to prevent potato scab.

C. 1 pt. Formalin in 12½ gals. water, for soil treatment. Use two-thirds to 1 gal. for each square foot of surface treated; cover for 24 hours after treatment; air afterwards, and stir soil; allow 7-10 days before seeding and 10-14 days before transplanting in this soil.

FORMULAS FOR LESS-USED FUNGICIDES.

OTHER BORDEAUX MIXTURES.

Dilute Bordeaux Mixture. Use 1 lb. copper sulphate, 4 of lime, and make as above directed. For second and third sprayings of apples to lessen russeting of the fruit.

Soda Bordeaux Mixture. 4 lbs. copper sulphate, 1⅛ to 1½ lbs. soda lye, 50 gals. water. Use only enough lye to make the solution alkaline to test paper. Used sometimes for late spraying of grapes, etc., where

Resin *Bordeaux* Mixture. Melt 5 lbs. resin with 1 pt. fish oil over re, cool slightly, add 1 lb. soda lye, stirring. Add 5 gals. water and oil till the mixture will dissolve in cold water. Mix 2 gals. with 48 of ordeaux mixture. Used sometimes on such glaucous plants as asparagus, abbage, onions, etc., to make a more adhesive spray.

POTASSIUM SULPHIDE.

3 ozs. Potassium Sulphide. 10 gals. Water.

Used chiefly in greenhouses, or for powdery mildews.

AMM. SOL. COP. CARBONATE.

5 ozs. Copper Carbonate.
3 pts. Ammonia. 45-50 gals. Water.

Use ***just enough*** ammonia (if strong, dilute with several volumes of ater) to dissolve the copper carbonate; then dilute to final volume. 'his fungicide is not as good as Bordeaux, but is used to avoid sediment n the foliage or fruit.

COPPER SULPHATE.

2 to 3 lbs. Copper Sulphate. 45-50 gals. Water.

Used chiefly as a winter spray. 1 lb. to 250 gals. water is sometimes sed on foliage. Now rarely used.

COPPER LIME-SULPHUR.

2 lbs. Copper Sulphate.
1½ gals. Com. Lime-Sulphur. 45-50 gals. Water.

Dissolve copper sulphate in part of the water, and then add with the lime-sulphur to the remainder. Apparently a good fungicide but likely to russet apples as does strong Bordeaux.

SULPHUR MIXTURE.

Various commercial forms of Sulphur as "Atomic Sulphur" and "Sulphur Paste," have fungicidal value, and have been used by us for summer spraying of peaches with little or no injury, at the rate of 8 lbs. to 45-50 gals. of water.

FORMALIN FUMES.

3 pts. Formalin. 23 ozs. Potassium Permanganate.
For each 1000 cu. ft. Space.

Place bulbs or tubers in 6 to 12 in. crates so fumes can get at them. To prevent injury to potatoes, fill space at rate of 167 bu. Place Formalin in large pail in cleared central space and drop in the crystals of potassium permanganate. Close room air-tight for 24 to 48 hours.

INSECT AND FUNGOUS PESTS OF CULTIVATED PLANTS.

ects, etc.

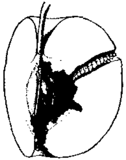
APPLE.

Bud-Moths: Case Bearers: Leaf Crumpler:—Small over-wintering caterpillars feed upon the unfolding leaves. Spray with lead arsenate as soon as leaf buds begin to open. Repeat a few days later, if necessary. Rept. 1909, p. 353.

Canker-Worms—During May small looping caterpillars devour the leaves and spin down on threads when disturbed. Spray foliage with lead arsenate before blossoms open, and again soon after they fall. In unsprayed orchards sticky tanglefoot hands should be placed around trunks of trees in October, kept sticky until January 1st, and again *kept sticky during April and May*. Rept. 1908, p. 777.

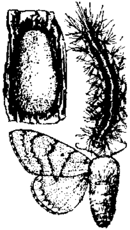
Tent-Caterpillar—During May the caterpillars form nests at the forks of the branches, and devour the leaves. Clip off and burn *egg masses on twigs in winter. Remove* nests with caterpillar brush. Spray with lead arsenate once before the blossoms open and again soon *after they fall*. Bull. 177, and Rept. 1913, p. 226.

Lesser Apple Worm—Larva feeds on ex-or of nearly *mature fruit, and often causes injury in storage.* ray as for Codling-Moth. Rept. 1910, p. 595.



Codling-Moth or **Apple-Worm**—Pink caterpillar tunnels inside the fruit, especially around the core. Spray with lead arsenate as soon as the blossoms fall. Repeat three or four weeks later. Keep foliage and fruit covered until fruit is nearly grown. Rept. 1910, p. 594.

Brown-Tail Moth: Fall Web-Worm—See Pear.



Gipsy Moth—Occurs in the United States only in south-eastern New England. Brownish hairy caterpillars defoliate trees in May and June. Band trees with tanglefoot, and with burlap, which should be examined each day to destroy caterpillars. From August to May egg-masses can be destroyed by soaking them with creosote. Spray foliage with lead arsenate. Bull. 186; Repts. 1905, p. 246; 1906, p. 235; 1907, p. 300; also placard.

Curculios—Grubs of both apple and plum curculios infest the fruit, making it gnarled *and ill-shaped.* Spray *twice after blossoms* fall as for Codling-Moth, and remove infested fruit in thinning. Rept. 1904, p. 219.

Green Fruit Worms: Palmer Worm: Leaf Roller—Caterpillars *all feed upon foliage* and immature fruit. Spray with lead arsenate, as for Codling-Moth.

Tussock Moths—Tufted caterpillars of several species feed upon he leaves in mid-summer. Spray with lead arsenate as for Codling-Moth. Rept. 1905, p. 230; 1907, p. 332; 1916, p. 105.

Yellow-necked Caterpillar: Red-humped Caterpillar—Feed in lusters and often strip young trees in fall. Hand-picking is easy iethod of control. Spray leaves with lead arsenate. Rept. 1901, . 274.

Maggot or **Railroad Worm**—Maggots tunnel through the pulp f the ripening fruit of sweet and sub-acid varieties, especially hose ripening early in the season. Destroy all infested fruit. Rept. 1910, p. 593.

Round-Headed Borer: Flat-Headed Borer—Grubs burrow in wood at base of trunks. Watch trees and dig out borers wherever sawdust appears. Paint trunk with lead arsenate and lime-sulphur. Rept. 1907, p. 333.

Leaf Hoppers—Whitish insects sucking sap from underside the leaves. Spray with nicotine solution, as for aphis.

Tarnished Plant Bug—Injures developing fruit by sucking sap, forming dimples. Spray vith nicotine solution as for aphis.

Red Spider: Clover Mite—Cause much injury to leaves, specially in dry seasons. Spray with kerosene emulsion or nicoine solution as summer treatment. Eggs of latter species killed y lime-sulphur spray in winter.

Leaf-Blister Mite—See Pear.

Green and **Rosy Aphids**—Green aphids suck sap from the leaves and terminal shoots, causing leaves to curl and checking growth. Rosy aphids infest fruit clusters, checking development. Spray with nicotine solution ($\frac{1}{2}$ pint in 50 gallons water), either separately or in combination with lead arsenate, lime-sulphur or Bordeaux Mixture. Repts. 1903, p. 259; 1909, p. 343.

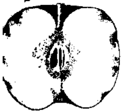
San José Scale—See Peach. Spray dormant trees with lime-sulphur or miscible oil. Bull. 165; Rept. 1904, p. 221.

Red Bugs—Two species of red leaf bugs suck the sap, causing leaves and fruit to become distorted. Spray with nicotine solution, as for aphis.

Woolly Apple Aphis—A bluish-white, cottony plant louse in colonies on bark, forming galls or swellings on twigs of small trees, and preventing wounds from healing; also on roots, forming galls, and destroying small feeding roots. Plant only clean or fumigated stock. Use tobacco dust in soil around trees. Spray above ground with kerosene emulsion.

Oyster-Shell Scale: Scurfy Scale—Scale insects with elongated or pear-shaped shells, on bark, suck sap from the twigs; the former about the same color as the bark, the latter light gray or whitish. Spray with nicotine solution; soap and water; or kerosene emulsion, about the second week in June. Bull. 143; Rept. 1903, p. 225.

'ungi, etc.



Baldwin Spot—Shows as small diseased masses of brownish tissue, usually a short distance beneath the skin; finally may appear at the surface as small, discolored, shrunken areas, then very similar in appearance to some of the fruit speck troubles. 'ot a fungous, but apparently a physiological disease. Thought y some to be due to unusual local loss of water; possibly may :art from punctures of Rosy Aphis or similar puncturing insects. 'o remedy known.

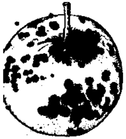
Cankers—Occur on branches and are caused chiefly by European canker fungus which eventually forms a cavity surrounded by concentric elevated rings of wood extending to bark, which each year is killed a little further, adding another ridge. Cut off infected branches, or cut out infected wood and bark; paint over cut surfaces. Keep orchard well sprayed and trimmed. Rept.

Black Rot—Causes mature fruit to rot, eventually turning it black; forms small brown spots on leaves; does some damage through cankers on branches, which are eventually killed. Treat as for Scab; prune and burn all dead limbs and twigs; cut out and paint over large cankers when found. Rept. 1909–10, p. 590.

Fruit Specks—Form more or less numerous, small, brown or black spots, starting at surface of fruit and slowly working inward; the true Fruit Spot often has a pinkish or purplish border in light-skinned varieties. Due to various fungi. Usually controlled by spraying as for Scab. Rept. 1909–10, p. 590.

Rust—Shows as orange-colored blotches on leaves, eventually producing minute fringed clustered-cups imbedded on the under side; less frequent on fruit. Rust spreads to the apple from the *cedar-apples*, which appear in the early spring on the red cedar. All cedars near the orchard should be destroyed. There is great difference in the susceptibility of different varieties to this disease. Spraying is only partially successful in this state, as the leaves must be well coated continuously with spray from the time they begin to unfold, until the end of July. Repts. 1891, p. 161; 1909–10, p. 591.

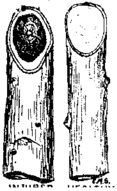
Scab—Produces "scabby spots" on fruit and leaves; rarely on twigs. Spray the unfolding leaves before the blossoms open, again after the petals fall, and follow with a third spraying about four weeks later. For first treatment, use strong Bordeaux, for second and third, weak Bordeaux or lime-



Sooty Blotch—Forms on fruit an olive-black superficial growth in distinct round colonies, or often merging together. Spray with Bordeaux as for Scab, or with lime-sulphur $1\frac{1}{2}$ to 50. Repts. 1909–10, p. 592; 1911, p. 367.

Blight—See Pear.

Spray Injury—Takes the form usually of burn on leaves and russeting on fruit. Is most likely to occur after second and later sprayings. Worst in wet seasons. Spraying in bright sunshine may cause some scorch of fruit on sunny side. Varies greatly with different sprays. Avoid those known to be injurious or injurious combinations (as soap and lead arsenate); use Bordeaux only for *first* summer treatment or on varieties not especially subject to russeting. Rept. 1911, p. 360.



Winter Injury—Takes various forms from different conditions, such as imperfect fertilization or russeting of fruit following late spring frosts; sun scorch of trunks due to mild winter weather followed by sudden cold; bud and twig killing, frost cracks in trunks, blackened wood, dead roots, etc., following unusually cold winters or unfavorable environment. Set out only hardy varieties; avoid planting in wet ground or on hillsides with extreme south or southwest slopes. Head trees low; avoid late fertilization and cultivation; keep earth tight around trunks; use cover crops. Repts. 1903, p. 303; 1906, p. 310; 1914, p. 6.

Storage Rots—Are troubles caused by a variety of fungi. Store fruit, in a dry condition, in a cool well aired place. Do not store in too deep piles or too tight receptacles. Use poorer keeping varieties first, and sort over if necessary. Apples from well sprayed trees keep best. Rept. 1915, p. 426.

General Treatment for Apple Orchards.

For the general control of fungi and insects on apples in Connecticut we make the following recommendations:

(1) Winter treatment (spraying dormant trees) is necessary only in the case of the presence of the San José scale, or leaf-blister mite, when commercial lime-sulphur, 1–9, or miscible oils, 1–15, may be used.

(2) As a rule, three summer treatments with a fungicide are necessary to control the fungous diseases, and the last two of these should contain an insecticide. These sprayings should be made as follows: 1st, just before the blossoms open, on the young unfolding leaves (April 27th to May 10th, according to the season and variety); 2nd, as soon as all the blossoms have fallen (May 10th to 30th); 3d, about one month later (usually June 10th to 25th).

(3) Where fungi are not prevalent, especially scab, the first summer treatment may be omitted. Occasionally, perhaps in

Where fungi are quite inconspicuous, the fungi-... [with el]...ly omitted, and only the two sprayings with [sap fr]... insects given.

[color] Spra...des, we recommend Bordeaux mixture of the ke...l for the first spraying, and of the 1–4–50 for the ...third sprayings; or commercial lime-sulphur, used at ...n of $1\frac{1}{4}$ to $1\frac{1}{2}$ gallons per fifty gallons of water, for all sprayings. The former has better fungicidal value, and the ...ter is less likely to produce spray injury, especially russeting of the fruit. Where fungi are prevalent, the former might be used, while with varieties russeting badly, as Baldwin, the latter is likely to prove more satisfactory; or use strong Bordeaux for first spraying and lime-sulphur for second and third.

Fungi.

(5) For the insecticide in the above, use lead arsenate, if in the paste form at the rate of three pounds per fifty gallons of the mixture, or if in the powder form one and one-half pounds per fifty gallons.

(6) If canker worms, tent-caterpillar, bud-moth, or brown-tail moth are causing damage, add lead arsenate to the first summer treatment, and if aphids are present nicotine solution should also be included. Nicotine solution may be added to any of the subsequent treatments to destroy aphids, red bugs, tarnished plant bug, etc.

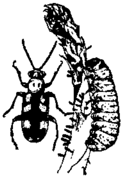
ASH.

Insects.

Oyster-Shell Scale. See Apple.

ASPARAGUS.

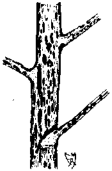
Insects.



Asparagus Beetles, Common and **12-spotted**—Adults and larvae devour the foliage. Cut everything clean during the cutting season; afterward spray with lead arsenate. Repts. 1902, p. 172; and 1903, p. 276.

Asparagus Miner—Larvae tunnel under epidermis of stem near base, causing premature death of plant above ground. Burn infested stalks. Rept. 1906, p. 303.

Fungi.



Rust—Produces (most conspicuous stages) small reddish or black elongated pustules scattered over stems. In fall, carefully gather and burn all stems from affected beds and escaped plants in vicinity. In gathering for market cut below the ground, as protruding stems offer opportunity for development of first stage of the fungus. Spraying with Resin Bordeaux partially controls the disease but this is difficult and expensive. Begin spraying the latter part of July and repeat about every 10 days until the middle of September. Thorough cultivation and fertilization, with plenty of humus in the soil, are advocated as beneficial. Grow varieties most resistant to the disease and select seed for new stock from resistant individuals if found. Repts. 1896, p. 281; 1904, p. 313.

ASTER.

sects.

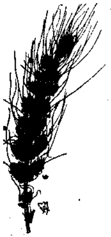
Blister Beetles—Three or four species feed upon the flowers, the black one being commonest. Practice hand-picking and cover choice plants with mosquito netting.

Fungi, etc.

Yellows—Shows in the yellowed and often imperfectly developed foliage and one-sided blossoms. A physiological trouble hose cause is not definitely known. Buy best seed; transplant ly healthy plants and have soil conditions good. Repts.)03, p. 306; 1914, p. 413 (26).

BARLEY.

sects.



Army Worm—See Grass.

Fungi.

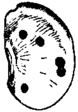
Rusts—See Oats and Wheat.

Smuts—Are of two kinds, covered and loose, both largely destroying the infected spikes and changing them into black, sooty structures, in the latter kind easily dissipated. Treatment, see Oats and Wheat. Rept. 1903, p. 306.

BEAN.

Insects.

Green Clover Worm—Occasionally green, wriggling caterpillars riddle the leaves in June and July. Dust string beans with air-slaked lime or other fine powder. Spray shell beans with lead arsenate. Rept. 1908, p. 828.



Weevils—Adults lay eggs in the pods in the field and continue to breed in the dried seed, finally rendering it unfit for food or for planting. Fumigate the seed with carbon disulphide, or heat in oven for 1 hour between 120° and 150° F. Bull. 195, p. 6.

Fungi.

Anthracnose—Shows on leaves and pods as roundish discolored areas, often with a purplish border. Save seed from pods showing no spots and plant these by themselves, selecting each year seed from unspotted pods for the seed crop and using remainder for general crop. Destroy all infected seedlings. Where very troublesome spray with Bordeaux, beginning when plants are only a few inches high and repeating about every 10 to 14 days until pods are forming. Rotation and destruction of old vines may prove helpful in keeping the trouble in check.

with el- much like anthracnose, but with discolored sap ing more of a translucent or watery character. co anthracnose. Repts. 1898, p. 262; 1903, p. 307.

Downy Mildew—Forms dense, white, woolly growths on pods and less luxuriantly on young stems and leaves of the Lima bean. As the fungus usually appears first and most vigorously in low moist places, the land used should be high or well drained. Serious only in years unusually moist after the middle of July. Spray with Bordeaux, beginning about the middle of July, and repeat every 10-14 days until the first part of September. Rept. 1905, p. 278.

Rust—Produces small, round, reddish or black, dusty outbreaks, usually *on the leaves. Plant varieties not likely to rust.* Burn the old infected plants in the fall. Rept. 1903, p. 308.

BEET-CHARD.

Insects.

Leaf-Miner—A small fly lays eggs in the leaves, and the larvae tunnel or mine between upper and lower surfaces. Practice clean cultivation. Destroy all infested leaves. Destroy all plants of the weed known as "lambs quarters" in which this insect breeds. Practice late fall plowing.

Fungi.

Leaf Blight—See Mangel. Rept. 1903, p. 309.

BEGONIA.

Eelworms.

Leaf-Blight Eelworm — Produces conspicuous dead areas on the leaves of Begonias (especially var. *Cincinnati*), ferns etc. Spots vary in size and shape according to host and disposition of larger veins Buy healthy stock only; keep infected plants by themselves and give them plenty of room; keep leaves as dry as possible and pick off and burn worst infected. Rept. 1915, p. 455.

BIRCH.

Insects.

Tussock Moths—See Apple, Hickory, and Horse Chestnut.

Birch Leaf-Skeletonizer or **Birch Bucculatrix**—Small greenish yellow larvae feed upon both sides of the leaves in late summer often entirely defoliating the trees. Spray with lead arsenate in July. Rept. 1910, p. 701.

Bronze Birch Borer—Grub makes spiral tunnel just beneath bark of upper main branches, ridges showing on outside. Cut and burn infested trees before May 1st.

BLACKBERRY.

Insects.

Blackberry Crown Borer—Larva tunnels in roots and at base of stem. Dig out and destroy.

Red-Necked Cane Borer—Larva tunnels in canes causing an irregular swelling or gall, often three inches in length. Cut and burn all infested canes in winter or early spring.

part of July. Spray about June 15th with lead arsenate. Rept. 1912, p. 236.

Fungi, etc.

Crown Gall—Forms hard galls or irregular excrescences on roots and lower parts of stems of blackberries, raspberries and several other hosts. Dig out and burn affected plants as soon as discovered. Never use infected stock for transplanting. A bacterial trouble. Rept. 1903, p. 354.

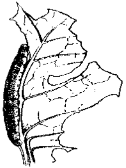
Leaf Spot—Forms on leaves small circular spots with whitish center and purplish border; also occurs on dewberry and raspberry. Not usually serious but where necessary it probably can be controlled by Bordeaux applied to the leaves, beginning before they have reached their full size. Rept. 1903, p. 309.

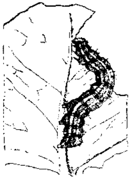
Orange Rust—Breaks out in spring or early summer as dusty masses of bright orange spores over the under side of the leaves. The fungus is perennial in the underground parts of the host, so that the disease appears year after year. Dig up and burn infected plants. Rept. 1903, p. 309.

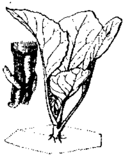
BOX.

Insects.

Leaf-Miner—A small two-winged fly lays eggs in the leaf and the larvae tunnel between the upper and lower surfaces. Destroy infested leaves. Fumigate the plants with hydrocyanic acid gas.







CABBAGE-CAULIFLOWER.

Insects.

Cabbage Worm—Green worms feed upon leaves all through season. Spray unheaded plants with lead arsenate. Use insect powder or hellebore on headed plants. Bull. 190, p. 9; Rept. 1903, p. 271.

Cabbage Looper—Smooth looping caterpillars feed with cabbage worms late in summer, and require same treatment. Bull. 190, p. 12, Rept. 1910, p. 706.

Cabbage Maggot—Infests stems of early set plants near surface of ground checking growth and often killing them. Practice crop rotation. Place hexagonal tarred paper disk around stems at setting time. Treat with carbolic acid emulsion. Bull. 190, p. 3; Repts. 1908, p. 832; 1914, p. 142; 1915, p. 114.

Cabbage Aphis—Sucks sap from the leaves. Spray with nicotine solution or kerosene emulsion. Bull. 196, p. 14.

Black (Bacterial) Rot—Forms black lines in veins of leaves. In time leaves turn yellow and easily drop off, and interior of head develops a general soft rot. As the germs can be carried on the seed, avoid seed from infected fields. *If in doubt*, treat seed in formalin, 1 part to 240 of water for 15 minutes. Keep refuse from diseased plants out of manure; practice rotation; make seed bed in new soil if disease appears in old one. Rept. 1912, p. 345.

Club Root—Causes knob-like enlargements on the roots of cabbage and allied plants. The germ *often* becomes established in the soil; when possible avoid such land and the use of refuse from old plants on the soil. Be especially careful that the seed bed is not infected. Infected land, *if used, should* be treated in the fall with lime broadcast at the rate of 80 bushels per acre and worked in. Rept. 1903, p. 310.

Soft Rot—See Salsify. Report 1903, p. 311.

CARNATION.

Insects.

Green Fly or **Aphis**—Sucks sap from young leaves and buds. Fumigate greenhouse with tobacco, or spray with nicotine solution or with soap and water.

Fungi.

Leaf Mold and **Leaf Spot**—Are two troubles much alike appearance, producing grayish spots with colored borders on ste leaves and calyx. Treat as for Rust.

Rust—Produces small dusty pustules, more or less confluen on the leaves and stems. Select, *if feasible*, only rust-resisti varieties. Spray in field with Bordeaux, adding 1½ lbs. soap each 50 gallons (helps mixture to adhere to plants). Select f transplanting only hardy and rust-free specimens. Keep air greenhouse as dry as is consistent with good growth. One or tw sprayings with Soap or Resin-Bordeaux, after transplanting greenhouse, may be given if desired; for repeated sprayings u potassium sulphide or weak copper sulphate. Rept. 1903, p. 31

Stem Rot and **Wilt**—Cause the lower leaves first to turn yello and dry up; then as the stem gradually rots off at its base, t whole plant becomes affected and finally dies. Select cuttin only from perfectly healthy plants, and if necessary start these sterilized soil and replant out of doors in new land, avoiding e cessive use of manure. If disease appears after setting out in t greenhouse, pull up infected plants upon appearance of fir symptoms, make liberal application of lime, avoid over-waterin and see that roots are properly aerated. Repts. 1897, p. 17 1903, p. 312.

CEDAR.

Insects.

Web-Worm—Small brown caterpillars feed upon the leav which they web together. ...

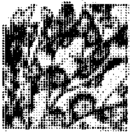
Cedar-Apple Rust—Appears in spring as conspicuous rounded galls with jelly-like horns bearing spores that carry the fungus to apple and related hosts. Cut off and burn all *cedar-apples*. See Apple Rust.

CELERY.

Insects.

Celery Caterpillar—Feeds upon the leaves of celery, parsley, fennel, carrot and parsnip. On the latter two plants lead arsenate may be used. On celery and parsley hand picking is perhaps the best remedy.

Fungi.

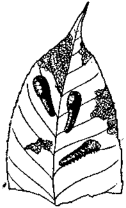


Leaf Blight and **Leaf Spot**—Are two diseases showing "rusty" spots on leaves and petioles; the latter trouble distinguished by the very minute black dots in the discolored spots (fig.), often progressing in stalks after storage. Spray the plants thoroughly in the seed bed with Bordeaux, as infected plants are often the means of introducing the trouble in the field. If necessary, continue the spraying after transplanting at intervals of about two weeks up to the middle of September. Before covering for bleaching, if leaf spot is abundant, dust with sulphur, and before final storage remove infected leaves and dust again. Rept. 1897, p. 167.

fined to the heart. Do not plant in too wet soil, avoid land wit green cover crops recently plowed in; in banking allow for prope aeration. See Salsify. Rept. 1914, p. 10.

CHERRY.

Insects.



Cherry or **Pear Slug**—Larvae eat away th green tissue from upper side of leaf. Spra with lead arsenate or with hellebore.

Canker Worms—See Apple.

Cherry Maggots or **Fruit Flies**—Larvae two species infest maturing fruit. Sprinkl foliage with sweetened lead arsenate in earl June to kill the adult flies.

Plum Curculio—See Plum.

Cherry Aphid—A brown aphid which suck sap from under side of leaves causing them to curl. Spray wit nicotine solution, soap and water, or kerosene emulsion.

Fungi.

Black Knot—Forms knot-like excrescences, usuall several inches long, on twigs and branches. Whe planting, use only trees free from this trouble; i the orchard, cut off and burn all infected branches i late fall or winter, painting over large cut surface Cutting *out* knots is rarely advisable, as new outbreak usually result. In cutting off, cut several inches belo the knot, to insure removal of the mycelial threads

the tissues. Remove all knots each year until they fail to reappear. Spraying in spring and early summer with self-boiled lime-sulphur or atomic sulphur helps to keep new knots from fruiting, but is entirely secondary in importance to the removal of the knots. Rept. 1911, p. 399.

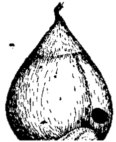
Brown Rot—See Plum. Rept. 1911, p. 402.

Leaf Spot—Shows as numerous, closely placed, purplish spots on leaves, which often have "Shotholes." Spraying, if begun on young leaves early in May, is effective but use the dilute Bordeaux, or better still, self-boiled lime-sulphur to avoid injury to the foliage. Give several sprayings at intervals of two weeks. This helps to keep down the brown rot also. Repts. 1895, p. 188; 1911, p. 401. Also known as Anthracnose.

Powdery Mildew—Develops a cobweb-like growth over the leaves; in fall forms numerous, minute, black fruiting-bodies, especially on under surfaces. Usually worst in young trees; controlled by spraying if necessary.

CHESTNUT-CHINQUAPIN.

Insects.



Canker Worms—See Apple.

Nut Weevils—Long-nosed snout beetles lay eggs in developing fruit and the grubs infest the nuts. Destroy all infested nuts. Fumigate nuts with carbon disulphide as for beans.

Two-lined Chestnut Borer—Long, slender, flat-headed larvae make sinuous tunnels under

Badly infested trees should be removed and burned, or tl bark removed before the insects mature *and spread to oth* trees.

Fungi.

Bark Disease (**Blight**)—Forms cankers in tl bark that eventually girdle infected limb ar cause death of parts above. Spreads over tr so that usually it dies within two to five year Rarely shade trees can be saved by careful cutting out and painting over the cankers. F forest trees it is best to let the disease take i course, and remove at least the larger trees wit in a year or two after their death to prevent deterioration the wood. Rept. 1912, p. 359; Bull. 178.

CHRYSANTHEMUM.

Insects.

Black Fly or **Aphis**—Sucks the juice from the young leaves ar flower stems. Fumigate the house with tobacco; dip the plan in or spray them with soap and water or nicotine solution.

Fungi.

Powdery Mildew—Develops a white mealy or cobweb coati on leaves. Use good judgment in airing and watering, and necessary spray from time to time with potassium sulphide

outbreaks, about the size of a pin head, chiefly on under sides of leaves. Avoid worst rusting varieties. Start with cuttings free from rust. Destroy rusted leaves, especially on cuttings. Early sprayings with dilute copper sulphate, potassium sulphide, etc., may help to prevent the trouble from getting a start. Rept. 1903, p. 315.

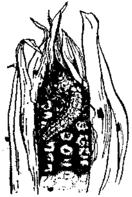
CINERARIA.

Insects.

Aphis or **Green Fly**—Sucks sap from the leaves and stems. Use nicotine solution, or soap and water, as a spray or dip.

CORN.

Insects.



Cut Worms—See Tomato.

Army Worm—See Grass.

Corn Ear Worm—Eats the immature kernels at the end of the ear. Dust with equal parts sulphur and powdered lead arsenate.

Fungi.

Leaf Blight—Kills parts of the leaves in August and September much like an early frost. Most injurious in wet late seasons. Plant early maturing varieties and stimulate growth by good fertilization and cultivation. Rept. 1903, p. 317.

appear on various parts of the plant. is especially injurious to certain varieties sweet corn. Avoid the use of fresh manu on the land. Seed treatment is ineffectiv The removal and destruction of spore mass is recommended by some writers.

CRANBERRY.

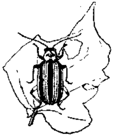
Insects.

Fireworm or **Black-headed Cranberry Wor** —Small, pale green, black-headed caterpilla web the leaves and new shoots together and feed inside t nest. Spray with lead arsenate to kill the caterpillars. Floo the bog for three days to kill the pupae.

Yellow-headed Cranberry Worm—Small, green yellow-head caterpillars injure plants in same manner as the preceding. Spra with lead arsenate. Keep bogs flooded until about May 20.

Cranberry Fruit Worm—Pale green larvae infest the berrie Flood the bog for about two weeks as soon as the fruit has bee harvested. Destroy all infested berries.

CUCUMBERS.

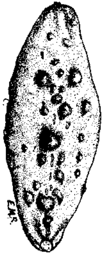


Insects.

Striped Cucumber Beetle—Attacks youn plants, eating the leaves. Larvae infest th main root or stem under ground, often killin the plant. Dust leaves with dry lead arsenat Cover plants with screens. Rept. 1908, p. 807.

the tissues. Remove
pear. Spraying in spMelon.
sulphur or atomic s
but is entirely Produces prominent discolored spots, more or
knots. Rept.n leaves; occurs occasionally on fruit. Treatment
Brown Ras for mildew. See Watermelon.

Leaf Mildew—Forms discolored spots as in preceding, but leaves shows a minute thin growth of upright threads bearing dark colored spores. Repeated sprayings with Bordeaux about every 10 to 14 days during the season, beginning at least by middle of July, usually keeps this disease in check. The same fungus occurs on Melons. Rept. 1904, p. 329.

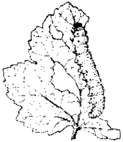


Mosaic and **White Pickle**—Are two very similar, if not identical, physiological diseases, showing in the former on the leaves as mottling of lighter or yellow-green areas scattered among the normally green tissues, and in the latter causing the fruit to become irregularly shaped, knobbed, and often mottled or whitish in color. Keep down sucking insects that may spread the disease, as it is infectious; pull up and destroy vines first showing it. Rept. 1915, p. 430.

Wilt—See Squash.

CURRANT.

Insects.



Currant Worm—Devours foliage in Ma
Spray with hellebore or lead arsenate. Rep
1902, p. 170.

Currant Borers—The larvae of two speci
of insects tunnel in the pith of the stem
causing the leaves to droop and wilt. D
stroy infested canes during May.

Currant Stem Girdler—Adults cut or girdle tip of new shoo
after laying eggs in them. Cut and burn these tips at any time
year. Rept. 1896, p. 238.

Currant Aphids—Yellowish-green aphids on under side
leaves causing them to curl. Underspray with nicotine solutic
or kerosene emulsion.

Four-Lined Leaf-Bug—A yellow and black striped bug suckir
sap from the leaves. Spray with nicotine solution.

San José Scale—See Peach.

Scurfy Scale—A conspicuous pear-shaped light-gray scale
bark, the insect sucking sap from twigs. Spray about secor
week in June with kerosene emulsion or nicotine solution. Bu
143; Rept. 1903, p. 227.

Fungi.

Anthracnose and **Leaf Spots**—Cause spo
on the leaves and usually their prematu
shedding; the former also spots the fruit
certain varieties. Spray with Bordeaux

If necessary continue spraying after harvest. Rake up and burn leaves in fall.

Blister Rust—Shows first as dusty orange-colored outbreaks about size of pinhead on lower surface of leaves, and later as short hair-like growths. Worst on black currants. Alternate host is white pine. Report presence to the Experiment Station. Rept. 1911-12, p. 347. See Pine.

CYCLAMEN.

Insects.

Leaf-Mite—*Transparent microscopic mites* cause leaves to curl, and plants do not blossom. Syringe under leaf surface strongly with water. Spray with, or dip plants in nicotine solution, 1 part in 400 parts of water. Rept. 1914, p. 176.

DAHLIA.

Insects.

Tarnished Plant Bug—Sucks the sap from the stems and buds causing them to fall. Spray with nicotine solution. Rept. 1904, p. 218.

Stalk Borer—Larva tunnels up and down inside the main stem, the top portion usually wilting and dying. Carefully make longitudinal slit in the stem and kill the borer.

EGG-PLANT.

Insects.

Flea Beetle—See Potato.

Colorado Potato Beetle—See Potato.

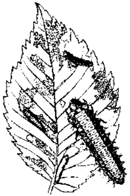
Fungi.

Fruit Rots—Caused by several fungi, the Gray Mold producin the most extensive rot. Spray with Bordeaux; pick off and car away the rotting fruit.

ELM.

Insects.

Spiny Elm Caterpillar—Clusters of black spiny caterpilla often strip certain branches of elm, willow, and poplar. Remo and destroy entire cluster or spray with lead arsenate. Rep 1906, p. 260.



Elm Leaf Beetle—Adult beetles eat hol through the leaves in May, and in June an July the larvae or grubs eat away the gree tissues from the under surface. Spray wi lead arsenate early in May to kill egg-layin beetles, or spray under surface of leaves wi same mixture about June 1st, to kill th larvae. Yellow pupae at base of trees ma be killed with kerosene emulsion or soap an water. Bull. 155; Rept. 1908, p. 815.

Canker Worms—See Apple.

White-Marked Tussock Moth—See Horse Chestnut.

Leopard Moth—Larvae tunnels in branches under the bar cutting deep galleries, often girdling the branch, which lat breaks off and falls to the ground. Small trees may be examine and borers killed by *injecting carbon disulphide, or by inserting* wire. Bull. 169; Rept. 1911, p. 117.

the tissues. Remove Melon.
pear. Spraying in sr
sulphur or atomic ... n soft scale, oval in shape with cottony
but is entirely Produ especially in the cracks of the bark of
knots. Rept leaches, sucking the sap. Spray with kerosene
as for 51; Rept. 1905, p. 235.
Brown Mildale—A whitish pear-shaped scale on twigs. Spray
Leaf shooth with kerosene emulsion.
dark colWoolly Aphids—Several species curl the leaves, or form in
everly masses on the bark. Spray with kerosene emulsion.
Fungi.

Leaf Spot—Shows as black slightly elevated specks more or less thickly imbedded in the leaves and causing their premature fall. Not usually so injurious as to merit the expense of spraying with Bordeaux, which should start on the immature leaves. Rept. 1909-10, p. 717.

EUONYMUS.

Insects.

Euonymus Scale—The various species of Euonymus are attacked and often injured by this scale, which has narrow white (male) or pear-shaped gray or brown (female) shells. Cut and burn infested twigs. Cover and fumigate with hydrocyanic acid gas. Spray with nicotine solution or kerosene emulsion during June to kill young. Bull. 151; Rept. 1905, p. 240.

Insects, etc.

FERN.

Hemispherical Scale—Brown, oval convex scales on fronds plants under glass. Apply soap and water or nicotine solut as a dip or spray. Bull. 151, p. 9; Rept. 1905, p. 239.

Leaf-Blight Eelworm—See Begonia.

GERANIUM.

Insects.

Greenhouse Leaf-Tyer—Small green wriggling caterpillars f upon the leaves of plants under glass. Spray with lead arsena

White Fly—See Tomato.

Fungi.

Gray Mold Rot—Produces dead spots on leaves and bl blossoms. Worst in poorly lighted and leaky greenhouses. K drippage off plants; avoid watering in cloudy or muggy weatl ventilate. Attacks as a semi-parasite a variety of greenho plants. Rept. 1903, p. 322.

GOOSEBERRY.

Insects.

Currant Worm—Devours foliage. Apply hellebore or l arsenate early in season. Rept. 1902, p. 170.

Gooseberry Fruit-Worm—Feeds inside the berry. Dest infested berries.

Currant Fruit Fly—See Currant.

Fungi.

Mildew—Forms a felt-like growth on fruit and lea of young shoots. Worst on European varieties, attacks currant, especially young shoots. Spray v

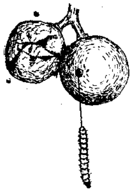
GRAPE.

Insects.

Grape Vine Flea Beetle—Adults and larvae devour the leaves. Spray with lead arsenate the latter part of June.

Rose Chafer—Long-legged brown beetles appear about June 15th and feed upon leaves, flowers and newly set fruit, often doing great damage. Cover choice plants with netting. Spray heavily with lead arsenate just before blossoms open and if necessary again after fruit has set. Rept. 1916, p. 111.

Grape Plume Moth—Small green spiny caterpillars web together the newly formed leaves at the tips of new shoots. Damage more apparent than real. Crushing by pinching these leaves is the best remedy. Rept. 1914, p. 190.



Grape Berry Moth—Larva feeds and develops inside the berries and is the cause of most wormy grapes. Spray with lead arsenate soon after fruit sets, and repeat twice at intervals of about ten days. Bag the clusters soon after the fruit sets.

Grape Root Worm—Adult beetles eat chain-like holes in leaves in July, and larvae or grubs devour the small feeding roots and eat channels in the bark of the larger roots

Sphinx and **Other Caterpillars**—Several species of horn wor as well as other kinds of caterpillars feed upon the leaves. Spr with lead arsenate or practice hand picking.

Grape Leaf-Hopper—Small, yellow and red-marked leaf-hopp sucking sap from under side of leaves. Spray under surface wi nicotine solution.

Grape Phylloxera—Sucks sap from roots and leaves, formi galls, and causing serious injury to European varieties. Graft native species.

Fungi.

Black Rot—Causes reddish-brown spots leaves; more rarely on stems; especially bad rotting the berries, which finally become har shrunken and wrinkled, black mummies. Tl is one of the worst diseases of the grape and oft difficult to control by spraying, which must thorough, especially the first season. Beg spraying before blossoming time, about the la of May, with second application just aft blossoming and subsequent sprayings at inte vals of about 10-14 days. Use Bordeaux up the last of July and then change to Soda Bordeaux or Amm. S Cop. Carbonate, though usually the 4 or 5 sprayings with Bc deaux are sufficient. Repts. 1889, p. 174; 1890, p. 100.

Downy Mildew—Develops usually dense white patches of fruiting threads on under side of leaves and causes more or less discoloration on the upper; also occurs somewhat on stems and fruit. Treat as for black rot. Rept. 1893, p. 77.

Gray Mold—Causes rotting of ripening greenhouse grapes, covering them with a more or less conspicuous grayish mat of fruiting threads. Remove rotting grapes from the house. Use care in ventilating and watering. If necessary spray bunches several times with potassium sulphide.

Powdery Mildew—Produces a cobweb-like growth over upper surface of leaves; most conspicuous in the fall, when the minute, round, yellowish to black fruiting-bodies are found scattered over surface. Treat as for black rot. Potassium sulphide is also used effectively against this fungus. Rept. 1895, p. 185.

GRASS.

Insects.

White Grubs—White grubs are the larvae of June beetles, and when abundant in the soil and approaching maturity, cause much damage, especially in seasons following drought, by eating off the roots of grass, corn, strawberries, etc. Plow just before October 1st to expose insects. Harrow very thoroughly before planting. Rept. 1912, p. 288; 1915, p. 179.

Fall Army Worm—Attack similar to that of army worm but occurs in September instead of July, and is more apt to be confined to lawns and millet. The worm does not migrate in such great numbers from one field to another. Same remedies app[ly]. Also practice late fall plowing. Rept. 1912, p. 284.

Army Worm—In certain seasons grasses and gra[in] are stripped of leaves and heads during July [by] brown striped caterpillars, which when abundant mo[ve] like armies from one field to another often caus[ing] great damage. Spray with lead arsenate, strips [of] grass or grain to protect fields not attacked. Pl[ow] deep furrows across line of march. Sprinkle migr[at]ing worms with kerosene. Use poisoned bran ma[sh]. Rept. 1914, p. 157.

HICKORY.

Insects.

Fall Web-Worm—See Pear.

Walnut Caterpillar—See Walnut.

Hickory Tussock Moth—White and black hairy caterpill[ars] feed upon the leaves in late summer. Spray with lead arsen[ate]. Rept. 1907, p. 332.

Hickory Bark-Beetle—Small black beetles breed under b[ark] and the galleries soon girdle the tree. Adults emerge, leav[ing] numerous round holes as if the bark had received a charge of b[ird] shot. Beetles also feed at base of compound leaf stems caus[ing] them to break and fall in midsummer. Has killed thousands [of] trees in Atlantic States. Badly infested trees should be remo[ved] before May 1st, and burned or at least the bark removed. Sp[ray] healthy and slightly infested trees about June 1st with st[...]

Hickory Borer—Larvae tunnel deep into solid wood of trunk. Hunt for sawdust, find the burrow, inject carbon disulphide, and plug the entrance.

Nut Weevils—Larvae infest the fruit or nuts. See Chestnut.

Hickory Gall Aphid—Curious galls on the leaf stems often cause the leaves to fall in midsummer. Galls contain large numbers of aphids. Spray with nicotine solution just as new growth starts in spring.

HOLLYHOCK.

Fungi.

Rust—Appears as small, compact, reddish-brown outbreaks on both leaves and stems. After their death in fall, cut off the plants close to the ground, carefully gather up these and any rubbish that may contain spores, and destroy them. Spraying with Bordeaux is recommended by some as helpful in checking the rust; begin as plants push through ground. Rept. 1895, p. 188.

HOP.

Insects.

Hop-Vine Borer—Larva tunnels in tip, checking growth, and later in the stem above and below the surface of the ground. Crush larvae in the tips, remove soil from the base, and after leaving the main roots exposed for a week, apply wood ashes or ammoniated phosphate and hill up. The plants will make new roots.

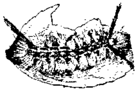
are small.

Hop-Merchants—Brown, spiny caterpillars of two species tortoise-shell butterflies feed upon the leaves. Spray with lea arsenate.

Hop Aphid—Green aphids suck the sap from the under le surface. Spray with kerosene emulsion.

Fungi.

Powdery Mildew—Coats leaves and stems with whitish pov dery growth, the mature fruiting bodies finally showing as loose imbedded blackish specks. Found here so far only on ornament varieties. Make several sprayings with commercial L. & Rept. 1911-12, p. 349.



HORSE CHESTNUT.

Insects.

White-Marked Tussock Moth—Tufte caterpillars devour leaves in midsumme Spray with lead arsenate. Rept. 190 p. 230; 1916, p. 105.

Fungi.

Leaf Spot—Forms extended reddish-brown areas on the leave frequently resembling sun scorch, but showing the fruiting stag as minute black dots in the dead tissues. This trouble can n doubt be controlled by spraying with Bordeaux, if the first applica tion is made on the unfolding leaves and is followed by one or tw subsequently on the mature leaves.

fruiting threads

HORSE-RADISH.

discoloration

Adults feed on the leaves, and larvae tunnel in fruit. Treat Spray with Bordeaux mixture and lead arsenate.

Gray

covering

fruit

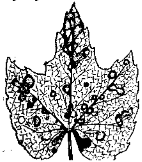
IRIS.

Root Borer—Larva tunnels in the rootstocks injuring many plants. Destroy infested rootstocks. In bad infestations burn over the beds in winter to destroy the eggs. Rept. 1915, p. 189.

Fungi, etc.

Leaf Blight—Forms elliptical spots with purplish border; if abundant causes leaves to turn yellow and die prematurely; worst on German Iris. Keep foliage coated with Bordeaux or L. & S., beginning early; gather and burn infected rubbish in late fall.

Soft Rot—Attacks rootstocks destroying lower parts so that leaves turn yellow and die. Same bacterial disease described under Salisfy. Propagate only from healthy stock; plant in well drained soil; use only well rotted manure; prevent winter injury of roots. Rept. 1903, p. 327.



IVY, BOSTON.

Fungi.

Leaf Spot—Forms conspicuous brownish spots with purplish borders, which run together if abundant. Leaf stage of black rot of grape. Give several sprayings with commercial L. & S., beginning on unfolding leaves. Burn leaves in fall.

KALE.

Insects.

Turnip Aphid—See Turnip.

Fungi.

Black Rot—Rept. 1915, p. 431. See Cabbage.

LARCH.

Insects.

Larch Sawfly—Larvae defoliate trees in midsummer. Spra with lead arsenate. Rept. 1915, p. 125.

Woolly Aphid—White cottony tufts on the bark and at the le whorls. Spray with kerosene emulsion.

LETTUCE.

Insects.

Aphid or **Green-Fly**—Sucks sap from leaves. Fumigate wi tobacco or hydrocyanic acid gas. Spray with soap and water.

Fungi.

Drop—Causes sudden wilting of plants t *infecting and rotting off leaves at surface* soil; often shows a white moldy grow over the basal parts. This may develop in a serious trouble in the greenhouse, as t fungus often becomes established in the so when the best remedy is to change the s entirely or sterilize it by steam or formal (formula C). Treat some days before using. Parsley is al subject to this disease in the greenhouse. Rept. 1908, p. 863.

second a white moldy growth in spots on the leaves. These diseases are held in check by sub-irrigation or care in watering and ventilating to keep plants and atmosphere as free from moisture as is consistent with good growth.

LILAC.

Insects.

Lilac Borer—A white larva tunnels in the twigs. Cut and burn infested twigs Rept. 1905, p. 260.

Oyster-Shell Scale—See Apple.

San José Scale—See Peach.

Fungi.

Powdery Mildew—Forms whitish cobwebby coating on leaves, with mature stage finally abundant as black dots. Conspicuous and common, but hardly demands preventive treatment.

LILY.

Insects.

Aphid—Yellow plant lice with red markings, on under side of leaves. Spray with nicotine solution.

Stalk Borer—See Dahlia.

LINDEN.

Insects.

Canker Worm—See Apple.

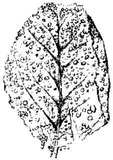
White-Marked Tussock Moth—See Horse Chestnut.

Linden Borer—A white larva tunnels in wood at base of trunk. Dig out borer, or inject carbon disulphide. Rept. 1915, p. 186.

Locust Borer—Larvae tunnel in solid wood o Inje carbon disulphide into the burrow and close the

MANGEL.

Fungi.



Leaf Blight—Shows as grayish circular spc with purplish borders; when abundant caus premature death of leaves. Rotate; keep refu out of manure piles; if necessary spray wi Bordeaux before disease gets started. Rep 1915, p. 432.

Root Rot—Rots off roots below ground, tur ing foliage yellow and often killing it. N common, but injurious occasionally in low wet fields. Avo wet ground; keep rotted plants out of manure. Rept. 1915, p. 43

MAPLE.

Insects.

Maple Borer—Larva tunnels in spiral cour upward around trunk or larger branches sugar maple working in sapwood and cambiu often girdling the trees. Examine trees in Se tember for sawdust. Find the burrow, inje carbon disulphide and plug the opening. Rep 1907, p. 336.

White-marked Tussock Moth—See Hor Chestnut.

Other Tussock Moths—See Apple.

Downy Mildew

fruiting threads -A See Apple.

discoloration

fruit. Tre Sp

Gray

cover Root

frants.

ov

Woolly Maple Leaf Scale—Cottony or woolly masses of wax, containing the females, eggs and sometimes larvae, appear on the under side of the leaves in midsummer; insects suck out the sap causing leaves to fall prematurely. Males and larvae enter crevices of bark of trunk and branches; larvae makes cases here and pass the winter. Attacks only sugar maples. Spray dormant trees with nicotine solution and soap. Burn all infested leaves. Bull. 151; Repts. 1905, p. 226; 1911, p. 345.

Cottony Maple Scale—Large, *oval*, brown soft scales on bark of branches of silver and red maples. Each scale in early summer develops a large cotton-like tuft of wax, nearly half an inch long, and soon after the young appear. Spray with miscible oils. Bull. 151; Repts. 1905, p. 237; 1913, p. 252.

Terrapin Scale—Small reddish-brown soft scales on small twigs of silver and red maples, sometimes killing the branches. Spray with kerosene emulsion. Bull. 151; Rept. 1905, p. 238.

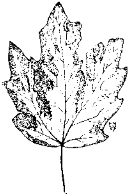
Oyster-Shell Scale—See Apple.

Maple Aphids—Green Aphids are common on under surface of leaves of Norway and Sycamore Maples in June. Spray with nicotine solution or kerosene emulsion.

Fungi, etc.

Anthracnose—Causes more or less extended dead areas in the leaves, often hard to distinguish from the leaf scorch. Its appearance depends on character of season and is difficult to forete but only occasionally serious. For this reason spraying of doul ful value in the long run, but when made should start on t unfolding leaves. Repts. 1903, p. 329; 1915, p. 436, unusi form.

Black (Tar) Spot—Forms slightly thickened black spots on t leaves, resembling finger prints. Cut-leaf maples are especia susceptible. Rake up and burn all leaves in the fall. Re 1908, p. 852.



Leaf Scorch—Causes more or less extend and irregular dead areas to appear sudden usually *from the leaf margins inward.* physiological trouble due to sudden or cessive evaporation beyond the supply water furnished by the roots, which is turn due to abrupt changes in atmosphe conditions, drought, injury to roots, e Pruning, when necessary, watering or mul ing, and stimulating root growth by nit genous fertilizers are probably best remedial measures. Re 1905, p. 267.

MARGUERITE.

Insects.

Marguerite Fly or **Leaf Miner**—A maggot tunnels betwe upper and lower leaf surfaces. Spray every ten or twelve da with nicotine solution. Rept. ...

Melon Aphid—Sucks the sap from the under side of the leaves, and when abundant causes much damage. Underspray the leaves with nicotine solution. Rept. 1908, p. 813.

Striped Cucumber Beetle—See Cucumber.

Fungi.

Anthracnose—Appears occasionally. See Cucumber and Watermelon.

Downy Mildew—Forms angular eventually brown spots in the leaves, often stunting or killing vines; most prominent just before melons ripen, later ones often not maturing or worthless because lacking flavor. It is questionable whether this trouble can be controlled effectively and profitably by spraying during a very moist season. During dry or semi-moist seasons, however, results are satisfactory, so we recommend spraying as one of the regular ooperations of melon growing. It should be started soon after the vines begin to run, at least by the middle of July, and the vines should be kept covered with the Bordeaux to the end of the season. Rept. 1904, p. 329.

Leaf Mold—Develops dead spots on the leaves very similar to those caused by downy mildew. Spray with Bordeaux on the first running vines and repeat every 10 to 14 days, making 4 or 5 applications according to season. Repts. 1895, p. 186; 1898, p. 225.

Wilt—See Squash.

Fall Army Worm —See Grass.

NASTURTIUM.

Insects.

Aphid—Brown aphids cluster on stems and leaves sucking th sap. Spray with nicotine solution.

OAK.

Insects.

Canker Worms—See Apple.

Brown-Tail Moth—See Pear.

Orange-striped Oak-Worm—Black and orange striped cate pillars feed upon the leaves late in summer. Spray with lea arsenate.

Fungi.

White Heart Rot—Forms on trunks shelf fungi, often somewha hoof-shaped, eventually with dark, creased and cracked, uppe surface and rusty-brown, porous, fruiting, lower surface. Gain entrance through wounded and dead branches; causes whit rot of heart wood and slow death of sapwood and bark. Brea off and burn fruiting bodies; if feasible cut out diseased bark an sapwood, and dig out dead heartwood and fill cavity with cement Occurs in other deciduous trees.

OATS.

Insects.

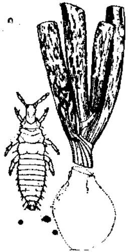
Army Worm—See Grass.

• **Downy Milde**
ruiting thread *ngi.*
liscoloration
ruit. Tr

Gray
cove

Black Stem Rust—Forms, chiefly on leaf sheaths and stems, first the II stage as reddish pustules and later the III stage as elongated black outbreaks. Also occurs on wheat, rye, and other grasses as different strains. The I stage appears in spring on barberry leaves as cluster-cups but the fungus can skip this stage. Quite serious in regions where grain is grown extensively, and difficult to control. This and several related species are becoming more important here as more grain of various kinds is grown.

Smut—Destroys the grain, turning it into a black dusty mass of spores. Seed treatment will prevent this smut. Either soak the seed 8 to 10 minutes in water at 132–5° F., or sprinkle thoroughly with formalin (formula A), stirring the grain so that it is thoroughly wet, and leave in piles for several hours before drying out. Buy seed from smut-free fields.

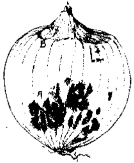


ONION.

Insects.

Thrips or "**White-Blast**"—Very small insects which feed upon the surface of the leaves, giving the field a whitish appearance. Burn all tops and refuse; burn over the grass land around the field to kill over-wintering insects. Spray with nicotine solution or kerosene emulsion. Repts. 1903, p. 266; 1913, p. 286.

Maggot—Infests the bulb of the young plant. Practice rotatior of crops. Spray plants here and there over the field witl sweetened lead arsenate to kill the adult flies. Rept. 1911



Fungi, etç.

Anthracnose (**Black Spot**)—Produces black circular spots on the bulbs, usually on whit varieties after storing in the barn. Stor onions as dry as possible and keep barı dry and cool. Avoid piling too deeply ir bins. Possibly air-slaked lime mixed witl sulphur scattered over them at time o storing may prove beneficial. See Stem Ro for treatment with formalin fumes. Fig. (A) Rept. 1889, p. 163.

Smut—Forms black dusty outbreaks on variou parts of plants raised from seed; especially injur ious to the very young seedlings. This fungu becomes established in the soil, hence infecte land should be avoided or used only for trans planted onions. If, however, it is seeded, appl with the seed in drills per acre, 100 lbs. sulphu thoroughly mixed with 50 lbs. air-slaked lime Formalin (1 lb. or 1 pt. to 12 or 15 gallons water thoroughly sprinkled over the seed, before covered by drip attachment to the seeder, is an eve more desirable remedy. Rept. 1889, p. 129

denly; others show irregular curling and yellow spotting of leaves. The cause of this trouble is not definitely known. It usually starts in fields in spots which enlarge year after year until the land is worthless for onions. Experiments indicate the value of treating the land, when the seed is sown, with formalin or with sulphur and lime, as for smut. Rept. 1906, p. 332.

Stem Rot—Causes rotting of bulbs at stem end, where they become soft and shrunken, sometimes showing beneath the layers a dense olive-brown growth of mold. This fungus in a moist season occurs on various parts of the plant in the field (possibly responsible for "blast" of seed onions), but does not usually appear as a serious trouble with the bulbs until some time after they have been placed in the barn. Treat same as for black spot. Late field spraying with Bordeaux shortly before pulling and again while lying in the field, combined with treatment by formalin fumes (See Fungicides) after storing, has given some indications of benefit. Fig. (B). Repts. 1903, p. 334; 1904, p. 321.

PAEONY.

Insects.

Rose Chafer—Adult beetles feed upon blossoms of white varieties. See Grape.

PALMS.

Insects.

Scales—Several kinds of white and brown scales infest the species of palms grown in greenhouses. Apply nicotine solution or soap and water as a spray or as a dip.

Anthracnose Frequently causes leaves to die at tip. Fungu inconspicuous, may show as small black imbedded specks oozin pinkish masses of spores. Avoid infected stock or isolate it pick off and burn worst infected leaves; keep leaves dry and hous well ventilated. Rept. 1913, p. 18.

PARSLEY-PARSNIP.

Insects.

Celery Caterpillar—On both hosts. See Celery.

Parsley Stalk Weevil—Larva tunnels in crown of plant. N remedy other than to destroy infested plants. Rept. 1913, p. 25

Fungi.

Drop—On Parsley. See Lettuce.

Soft Rot—On Parsnip. See Salsify.

PEA.

Insects.

Green Pea Aphid—Attacks the plants early in June and suck the sap from the leaves and stems, often causing great injur Early peas may mature a crop before aphis injures them. Spra vines with nicotine solution and soap. Brush the vines jus before cultivating. Repts. 1899, p. 240; 1913, p. 235.

Pea Weevil—The adult lays eggs in the pods in the field an the larvae develop in the seed, emerging through round hole Fumigate with carbon disulphide. Bull. 195, p. 5.

Fungi.

Leaf Spot and **Powdery Mildew**—The former shows as roundis spots on both pods and leaves; the latter, as a mealy or cobwel

Downy Mild
fruiting threa ngi.
discoloratio **Bl**ame. Neither seems to be sufficiently injurious
fruit. T ant the expense of spraying.

Gr
co

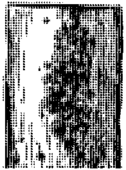
PEACH.

Peach Saw-Fly—Larvae feed upon leaves in June and July. Spray with lead arsenate. Rept. 1907, p. 285.

Peach Borer—Larva tunnels in the base of the trunk. Dig out in late fall and early spring. Paint base of trunk with lead arsenate and lime-sulphur. Rept. 1909, p. 359.

Fruit Bark-Beetle or **Shot-Hole Borer**—Makes minute tunnels under the bark of branches and runk. Burn infested trees and keep others thrifty. Rept. 1896, p. 240.

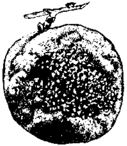
Plum Curculio—See Plum.



San José Scale—Minute scale insects, with circular shell, which suck the sap from twigs, fruit and leaves. On fruit a red spot surrounds each insect. Spray dormant trees with lime-sulphur. Bull. 165; Rept. 1901, p. 240.

Black and **Green Aphids**—Suck the sap from the leaves and shoots. Spray with

Fungi, etc.



Brown Rot—Occurs on the young twigs etc., but causes most serious injury to th fruit, *rotting it about the time of its maturity* The rotten areas usually become covered wit numerous pustules of dusty brownish spores eventually the diseased fruits form har mummies. These carry the fungus over th winter, and if half buried in the soil develo in early spring the mature stage, which causes infection of th blossoms, etc. Certain early varieties, like the Champion, ar especially subject to rot. Spraying these apparently pays i this state. See general directions for treatment. This fungu occurs on plums and cherries and less commonly on pears an apples. Repts. 1909-10, pp. 607, 612; 1911, pp. 374, 391.

Crown Gall—See Plum.

Leaf Curl—Causes young leaves to becom irregularly curled and swollen and finally t drop off; rarely on fruit. In April as soon a buds begin to swell, spray the trees thoroughl with commercial lime-sulphur 1-9. If mor convenient this may be done in late fall an is claimed to be just as effective. Same treat ment takes care of San José Scale. Rept 1909-10, pp. 608, 612; 1911, p. 374; 1914, p. 1

Powdery Mildew—Forms a grayish felt o young twigs and leaves. Prune off infecte

Scab—Produces roundish, olive-black spots on the fruit, discolored areas on the young twigs, and rarely "shot-holes" in the foliage. Two treatments with self-boiled lime-sulphur, atomic sulphur or sulphur paste upon the fruit after setting and when half grown (about the middle of May and June) will control this trouble. Repts. 1896, p. 269; 1909-10, pp. 608, 614; 1911, pp. 375, 391.

Spray Injury—Is more likely to occur with same treatment than on apple, which see. Avoid Bordeaux altogether. See (3) under general treatment following. Repts. 1900, p. 219; 1911, p. 372.

Winter Injury—Shows in various ways. In severe winters, especially when the ground is bare, the roots may be killed without injury to parts above the ground. In spring such trees put forth a scanty sickly foliage that soon drops. Often the injury occurs in the form of a "collar girdle" in the bark at the base of the tree. Sometimes it occurs above ground in the wood (shown by its blacker color), with or without injury to the bark. When the bark is not injured, severe pruning in spring will often save the trees. Nursery trees can sometimes be cut back to the snow line, below the injury, and an entirely new healthy trunk started. Avoid late applications of nitrogenous fertilizers and cultivation after middle of July. Mulch base of young trees in late fall with earth. Secure good drainage. See Apple. Repts. 1903, p. 341; 1908, p. 872.

in bunches on the trunk. This is claimed to be a contagiou disease, but it is apparently physiological in nature. Little peac in this state is scarcely to be distinguished, showing chiefly in th small backward fruit. Root out and burn all trees as soon a found; prevent winter injury; be careful in selecting stock fo planting. Repts. 1893, p. 92; 1908, p. 872.

General Treatment for Peach Orchards.

(1) Spraying of peaches while dormant is of value only : checking San José scale, mites and leaf curl. One applicatic of commercial lime-sulphur, 1-9, either in late fall or early sprin will take care of all of these troubles at the same time. If th scale and the leaf curl are unusually prevalent, both applicatior will prove of value in controlling them.

(2) For the prevention of scab and rot of peaches, it is as rule desirable to give three sprayings, as follows: 1st, shortl after the blossoms have fallen (May 15th to May 25th); 2n about three or four weeks later (June 5th to June 15th); and 3 about one month later (July 5th to July 15th). If only tw sprayings can be given, omit the first if spraying only for ro and the last if spraying only for scab.

(3) On the whole, self-boiled lime-sulphur of the 8-8-5 formula seems to be the safest and most reliable peach spra Fair results have been obtained with some of the commerci lime-sulphurs, and they are much more easily handled. There i however, some danger of spray injury, especially with certai

fruiting threa ... ngiam ...
discoloratic Bt ...nercial lime-sulphur is used, a strength of not fruit. T ... ar 1-150, without poison, is recommended. Atomic ...1 sulphur paste have given good results.

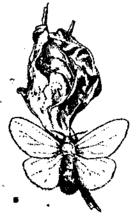
Gr... ..s lead arsenate has d... ..e little to prevent curculio injury, co... it seems to increase the danger of spray injury, we advise ...ving it out unless there is considerable danger of sawfly injury, when it can be added in the second spraying the same as for apples.

PEAR.

Insects, etc.

Pear or **Cherry Slug**—See Cherry.

Codling-Moth—See Apple.



Brown-Tail Moth—Occurs in the United States only in eastern New England. Brown hairy caterpillars feed on leaves, and make winter nests on twigs, maturing about the middle of June. Cut and burn winter nests. Spray foliage as soon as blossoms fall, and also in August, with lead arsenate. Rept. 1910, p. 683; Bull. 182.

Fall Web-Worm—Makes nests on ends of branches *of many kinds of trees in late* summer, the brown, hairy caterpillars feeding inside the nests. Clip off and burn nests when small. Spray with lead arsenate. Rept. 1901, p. 270.

San José Scale—See Peach.

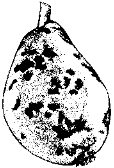
Pear Psylla—Small jumping plant lice suck sap from leaves and twigs, causing leaves to fall in midsummer. Spray with lime-sulphur in spring just before buds open. Spray infested tre... with nicotine solution in July. Rept. 1903, p. 262.

Pear Thrips—A minute insect which feeds upon the unopen... fruit buds destroying them so that fruit does not set. Spray wi... nicotine solution just as buds open, and again after blossoms fa...

False Tarnished Plant Bug—Punctures developing fruit causi... it to be irregular and knotty. Spray with nicotine solution a... soap.

Leaf Blister Mite—Attacks unfolding leaves of apple and pea... forms galls or blisters which become red and later brown. Caus... many leaves to fall in July. Spray dormant trees with lim... sulphur in late fall or in spring. Rept. 1910, p. 700.

Fungi, etc.



Scab—Forms olive-black scabby spots ... fruit and leaves, often causing the former ... become distorted and cracked. The fung... lives over winter on the twigs. Certain var... ties are not much injured, others, like Flemi... Beauty, are very susceptible. Spray wi... Bordeaux on unfolding leaves before blosso... open, *again after petals fall, and give the thi...* spraying about two weeks later, using wea... Bordeaux in last two treatments. Repts. 1894, p. 135; 190... p. 323; 1911, p. 396.

Blight—Kills young twigs, the leaves suddenly turning blac... also produces sunken dead areas on trunks. This is a bacteri... disease chiefly spread by bees during blossoming time or ...

several inches below the diseased area. Cut out cankered areas and swab with disinfectant, paint exposed wood when dry. Several weeks after blossoming remove all young dead twigs. Use knife sterilized from time to time by wiping with a cloth saturated with carbolic acid or with corrosive sublimate (1-1,000). This disease occurs also on apple and quince. Rept. 1894, p. 113.

Leaf Blight—See Quince.

PHLOX.

Insects.

Red Spider—Injures leaves causing them to turn yellow. Spray with kerosene emulsion, or with nicotine solution and soap.

Fungi.

Powdery Mildew—Covers more or less completely leaves and young stems with grayish coating within which are finally imbedded numerous, small, blackish fruiting-bodies. Give several sprayings with commercial L. & S., starting before mildew gains much headway.

PINE.

Insects.

Sawflies—Larvae of several native and imported species feed upon the leaves. Spray with lead arsenate.

White Pine Weevil—Adult snout beetle lays eggs on leader in May and grubs feed and develop in it, causing it to wilt and die in midsummer. Leaders of ornamental trees may be protected by spraying them with lead arsenate or lime-sulphur. Jarring the adults into a net once a week during month of May, serves and destroyed. Rept. 1911, p. 307.

Pine Leaf Scale—Whitish pear-shaped shells on leaves; smal trees sometimes killed. Spray with nicotine solution or kerosen emulsion about the second week in June. Bull. 151; Rept. 1905 p. 240.

Pine Bark Aphid—White cottony or woolly objects on bark an sometimes on leaves, sucking out the sap. Spray with kerosen emulsion. Rept. 1911, p. 343.

Fungi, etc.

Blight (so-called)—Stunts the leaves and kills their tips inward often suddenly, so that the tissues for a greater or less distance ar reddish-brown. This is a physiological disease; not contagious due to adverse weather conditions. Chief among these are sever winters, killing the leaves directly or indirectly through injur to roots; warm days, in late winter or early spring when groun is frozen, causing transpiration of water from the leaves that can not be replaced; very late spring frosts, killing tips of new leaves sudden changes, in summer from moist or muggy weather to brigh sunshine resulting in excessive transpiration and injury; very dr summers. No effective remedy. Rept. 1907, p. 353.

Dampening Off—Caused here chiefly by Rhizoctonia fungu rotting base of the stem, the seedling falling over. Sometime it creeps up the stem invading the base of the leaves which wither Certain conifers more subject to attack then others. Avoi unnecessary watering; provide good ventilation; infected soi often can be helped by treatment with formalin before seedin

Downy Mild

uiting three ... (Bordeaux ... alin C); spraying with Bordeaux effective in iscoloratic ... s. 1912, p. 348; 1915, p. 450. uit. T ... sulr

Gr ... s le ... it ... ving ... wher

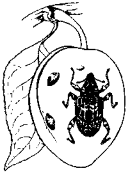
Stem Rusts—Form on the swollen stems temporary, but conspicuous, white, blister-like spore cups filled with a dusty orange-colored spore mass. The white pine blister rust, an imported species, spreads to the gooseberries and currants, and forms other less conspicuous leaf stages on these (*q. v.*). A very similar native species on two and three needle pines spreads to the leaves of the sweet fern. In either case infected pines should be destroyed, and watch kept of the alternate hosts, if they occur in the neighborhood. Seed beds should never be made in the vicinity of the alternate hosts, as nfection takes place easily in the young pine seedlings. In white pine plantations pull out all currants and gooseberries ncluding those in the immediate neighborhood (500 feet). Send ny suspicious white pines or their alternate hosts to this tation for examination. Rept. 1912, p. 347.

PLUM.

nsects.

Plum Aphids—Suck sap from leaves. Spray with kerosene

San José Scale—See Peach.



Plum Curculio—Grub infests the growing fruit, causing it to fall. Jar the trees each morning for six weeks after blooming and catch the beetles on sheets and destroy them. Spraying with lead arsenate during the same period is also advised. Rept. 1910, p. 609.

Fruit Bark-Beetle or **Shot-Hole Borer**—See Peach.

Fungi.

Black Knot—See Cherry.

Brown Rot—Thin fruit so it does not touch. Gather and destroy all mummies after harvest. Rather difficult to contro by spraying, as spray does not readily adhere to the smoot fruit. First treatment with self-boiled lime sulphur, should b made on half grown fruit, second 14 days later, and last 10-1 days before picking. See Peach.

Crown Gall—Forms hard roundish knots one-half inch or mor in diameter, near crown or on roots, less frequently on lowe part of trunk. Do not plant infected trees. Remove knots whe found and paint over cut surface. This is said to be very trouble some in some states, but here, as yet, little damage has resulte from it except possibly on blackberries and imported roses. I also occurs on peach, apple, raspberry, and various ornamenta

Poplar Tent-maker—Larvae feed on leaves and fold them together near ends of branches, forming nests. Spray with lead arsenate. Rept. 1911, p. 310.

Spiny Elm Caterpillar—See Elm.

Tussock Moths—See Apple, Hickory and Horse Chestnut.

Poplar Borer—Larvae make large galleries in wood of trunk. Dig out, or inject carbon disulphide into the burrow and close the opening. Rept. 1907, p. 336.

Poplar and **Willow Curculio**—Larva tunnels in smaller trunk and branches. Destroy badly infested trees. Cut out borers; inject carbon disulphide. Rept. 1907, p. 335.

Oyster-Shell Scale—See Apple.

Fungi.

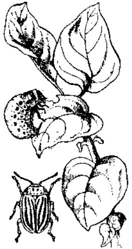
European Canker—Forms sunken dead areas of varying extent in the bark. Importation from Europe; showing here most commonly on Lombardy and white poplars. If trees are badly injured cut down and burn; otherwise cut out diseased areas going into the healthy bark, scraping, and painting over exposed wood if surface is extended.

Rusts—Show on leaves as minute, powdery, yellow-orange pustules in II stage, and as slightly elevated reddish blisters in III stage. Have I stage, for different species, on larch and hemlock. Avoid planting near these hosts in nursery; rake up and burn infected leaves in the fall. Rept. 1915, p. 440.

Apids—Black aphids suck sap from stems and leaves. Spra with nicotine solution.

POTATO.

Insects.



Flea Beetle—Small black jumping beetl eat holes through the leaves. Spray heavil both upper and under leaf surfaces wit lead arsenate. Rept. 1906, p. 271.

Colorado Beetle—Adults and larvae devo the leaves. Spray with lead arsenate s soon as injury is apparent. May be used i Bordeaux mixture. Rept. 1911, p. 311.

Three Lined Potato Beetle—Larvae fee upon the leaves and carry their black ex crement on their backs. Spray with lea arsenate.

Stalk Borer—Larva tunnels inside the stalk. Burn infeste vines.

Potato Aphid—Green aphids appearing i large numbers suck the sap from shoot and stems, causing much damage in 1917 Spray with soap and nicotine solution.

Fungi, etc.

Black Leg—Causes a black rot of ste below ground; plants more or less stunte

rith yellowish curled foliage; occasionally rots tubers. Usually nly scattered plants in the field, apparently not spreading to he healthy. Soaking seed in formalin as for scab said to be ıelpful. Rept. 1914, p. 21.

Blight or **Downy Mildew**—Causes a sudden blackening of the leaves, and often death of vines, from July to September in moist seasons; usually shows a slight whitish growth of fungus on the under side of the leaves; rots tubers. Spray with Bordeaux before the trouble appears, about July 1st, and keep vines well covered to the end of the season. Three to five sprayings by hand or five to seven by power sprayer are necessary. After ast cultivation thoroughly ridge up the rows to help keep the spores from washing down to the tubers. Early varieties often scape blight by maturing before its appearance. Repts. 1904,). 363; 1905, p. 304; 1909-10, p. 739; 1915, p. 470; 1916, p. 355.

Mosaic—Shows as a more or less conspicuous yellow-green mottling of the leaves. A physiological disease not well understood. New here but apparently not so injurious as in some other places. Do not save tubers for planting from hills showing this trouble.

Powdery Scab—Differs from common scab by smaller, more nearly circular and often powdery spots, with epidermis elevated at margins. Recently imported into Maine; rarely brought here on seed potatoes. Our experiments all indicate that this disease will not propagate in this state under ordinary conditions so it is

seasons infection might occur. If necessary, soak seed in formalin as for common scab, and roll in sulphur afterwards. Fig. (A) Rept. 1915, p. 463.

Scab—Produces the common scabby appearance on surface of tubers. Soak seed tubers one and one-half hours in formalin (formula B). Formalin fumes (see Fungicides) are often used when large quantities are treated. Care in filling space sufficiently however, is necessary to avoid injury by "pitting" from absorption of fumes. Avoid planting on infected land, by systematic rotation. The use of lime, wood ashes and various barnyard manures will increase the amount of Scab. The same trouble occurs on beets and turnips. Fig (B). Repts. 1890, p. 81; 1891, p. 153; 1894, p. 118; 1895, p. 166; 1896, p. 246; 1909-10, p. 744.

Tip Burn—Causes leaves to die at tip and margins and roll up often mistaken for true blight. This is a physiological trouble du to drought or sudden change from moist to very hot bright weather Cultivate thoroughly and often to conserve moisture. Spra with Bordeaux as for Blight, as this often helps to increas yield by lengthening life of leaves.

PRIVET.

Insects.

Privet Leaf Folder—Larvae web together terminal leaves an feed inside. Clip off and destroy infested shoots. Spray wit

Fungi.

Anthracnose—Forms small cankers on stems causing parts above to wilt and die. Usually found in nurseries on recently transplanted European privet. Prune off and burn infected branches; if bad spray with Bordeaux. Rept. 1914, p. 22.

Winter Injury—Shows in spring by stems usually being killed down to base or snow line. Cut off dead stems below injury and a vigorous new growth will result if roots are not injured. Rept. 1904, p. 326.

QUINCE.

Insects.

Round-Headed Borer—See Apple.

Quince Curculio—Grubs infest growing fruit and adults feed upon it causing it to be knotty. Jar the trees same as for plum curculio. Spray with lead arsenate.

Aphid—See Apple.

Fungi, etc.

Black Rot—Rots the fruit, often beginning at the blossom end; also kills twigs and branches. In the fall or spring cut off and burn all dead branches. Give three sprayings, as for Leaf Blight, with Bordeaux mixture.

Blight—See Pear.

Leaf Blight—Forms rounded, often confluent, reddish-brown spots with central black dots on leaves and fruit, the former often shedding prematurely and the latter cracking irregularly. Spray with Bordeaux just before blossoms open, again soon after they about 2 weeks, according to the weather. This fungus also occurs on pear. Repts. 1890, p. 99; 1891, p. 150.

Rust—Produces small clustered cups, with fringed borders and filled with orange spores, on fruit, young twigs and less frequently on leaves. Cut off and burn infected twigs and fruit. Treat as for apple rust.

RADISH.

Insects.

Maggot—See Cabbage.

Aphid—See Turnip.

Fungi.

Club Root—See Cabbage.

RASPBERRY.

Insects.

Raspberry Sawfly—Larvae devour leaves. Spray with lead arsenate or hellebore.

Cane Borer—Larva tunnels inside the canes. Cut and burn infested canes.

Fungi, etc.

Anthracnose—Shows as more or less confluent whitish spots with purplish borders, on the stems. In spring, before buds swell cut out and burn all badly infected canes and then spray with Resin Bordeaux. If disease is very bad, spray again when young shoots are about six inches high, and repeat in 10 to 14 days. Aim chiefly to cover the young shoots with the spray. After fruit is gathered, again remove any badly infected canes. Cultivate

with yellowish ghly to promote vigorous growth of canes. Rept.
only scattered
the healthy.
helpful. R all—See Blackberry.

See Blackberry.

—Forms cankered areas on the canes causing the parts above to wilt. In the old canes and near the pruned ends, the fungus often develops a brownish coating of spores around each small imbedded fruiting receptacle. The green berries often dry up without apparent cause, due to inoculation by insects. Spraying has not proved very satisfactory. Old and diseased canes should be removed and burned after the fruiting season and again early in spring. Rept. 1906, p. 321.

Yellows—Causes foliage to become more or less crinkled, and mottled with a sickly yellowish color. Plants gradually become worthless. Spraying does not seem to help this trouble, which apparently is of similar nature to peach yellows. Dig out plants with the yellows. Propagate only from perfectly healthy ones.

RHODODENDRON.

Insects.

Rhododendron Lace Bug—This bug sucks the sap from the under side of the leaves, which are usually colored brown by its excrement. Spray with nicotine solution or kerosene emulsion. Rept. 1910, p. 708.

Fungi, etc.

Leaf Scorch—Shows as dead marginal areas of varying width

mulched; water if necessary in dry weather by soaking groun beneath mulch. Rept. 1914, p. 23.

ROSE.

Insects.

Rose Slug—Eats away the green portion of the leaves. Spra with hellebore, lead arsenate or nicotine solution.

Rose Chafer—See Grape.

Leaf-Hopper—Sucks the sap from the under side of the leave Spray with nicotine solution.

Rose Scale—Whitish circular shells on the stems contai insects which suck the sap. Cut and burn worst infested cane Spray with nicotine solotion.

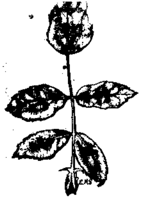
Aphid or **Green Fly**—Sucks sap from the leaves and stem Spray with nicotine solution.

Fungi, etc.

Crown Gall—Occurs very frequently on ro roots, especially imported ones of Manet stock. Inspectors now destroy all infecte stock. There is some question how much in fected plants eventually suffer. See Plur Rept. 1911-12, p. 355.

Leaf Blotch—Forms large purple-black blotches on leaflet which often turn yellow and fall off. For greenhouse treatme paint hot water pipes with mixture of sulphur and oil. Potassiu sulphide or commercial lime and sulphur can be sprayed on th

leaves. Rept. 1903, p. 355.



Mildew—Develops a white powdery or cobweb-like growth on the young leaves, which become more or less distorted and fall off. Tea roses especially susceptible. Treat same as for leaf blotch; or dust flowers of sulphur over the leaves; be careful in airing greenhouses. Rept. 1903, p. 356.

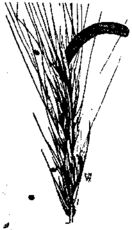
RUTABAGA, See TURNIP.

RYE.

Insects.

Army Worm—See Grass.

Wheat Midge—See Wheat.



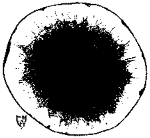
Fungi.

Ergot—Forms conspicuous, elongated, purplish sclerotia, usually one in the spike, most common in volunteer rye, but occasionally abundant in cultivated fields. Keep these sclerotia out of cattle feed as they may cause abortion and other troubles.

Powdery Mildew—Shows as a thick grayish felt on the leaves with fruiting bodies as blackish embedded specks. Causes practical remedy. Rept. 1909-10, p. 735.

SALSIFY.

Fungi, etc.



Soft Rot—Forms a soft rot of the in terior tissues of the roots running dow from the crown and turning them darker color. Usually occurs after stor age. Same bacteria cause soft rots in variety of plants. Avoid contaminate manure and too much rotting humus i the fields; store under dry cool conditions, allowing sufficien ventilation. Rept. 1914, p. 25.

SNAPDRAGON.

Insects, etc.

Leaf Mites—Causes leaves to curl and plants do not blossom Spray with nicotine solution. Rept. 1914, p. 176.

Root-Knot Eelworm—Causes irregula swellings on the roots where the eelworm are present, with resulting premature deca and sickly appearance of parts above ground Worst in greenhouses and hot-beds as thi far north the nematodes are killed in un protected ground over winter. Attack root of a great variety of cultivated plants. Pur chase only healthy plants; change infecte soil if possible, dry out thoroughly in sum

with yellowish ghly to Pver winter or sterilize with steam; only scattere soil with infected refuse. Rept. 1915, the healthy all—See helpful. See Bla

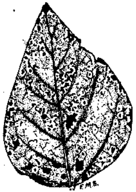
Form—Shows as whitish spots with distinct purplish ove to wives and stems; spots often running together. Select fungus of ttings only from healthy stock; pick off and burn small in eaves. Spray with Bordeaux.

up w—Forms reddish-brown, roundish pustules chiefly on under le of leaves causing tissues above to become yellow spotted. Recently appearing in greenhouses and causing more or less injury according to prevalence. Treat as for anthracnose.

SNOWBALL.

Insects.

Aphids—Suck sap from the leaves causing them to curl. Use nicotine solution as a spray or dip.



SOY BEAN.

Fungi, etc.

Bacterial Leaf Spot—Forms small, dark, reddish-brown angular spots frequently merging into larger areas. Certain varieties appear more susceptible than others, Ito San being one of the worst. Grow least susceptible varieties and if possible purchase seed from uninfected fields.

Crinkling Chlorosis—Shows as crinkling

both together. Plants less vigorous than normal ones. Hollybrook variety apt to show trouble most. Treatment same as in preceding.

SPINACH.

Insects.

Spinach or **Beet Leaf-Miner**—See Beet.

SPIRAEA.

Insects.

Aphids—Suck sap from the new shoots. Use nicotine solution as a spray or dip.

SPRUCE.

Insects.

Spruce Gall Aphid—Forms galls at the base of the new growth on Norway and other spruces. Spray in the late fall or early spring with nicotine solution and soap or with kerosene emulsion Rept. 1906, p. 302.

Spruce Bud Moth—Larva feeds on leaves o terminal shoots of the branches causing much damage. Spray with lead arsenate. Rept. 1912 p. 291.

SQUASH-PUMPKIN.

Insects.

Squash Lady-Beetle—Both adults and larvae devour the leaves. Spray with lead arsenate. Bull. 181, p. 11; Rept. 1908, p 8

Cucumber

bug three fourths of an inch in length sucks the sap from the under side of the leaves, causing them to wilt and die. Spray with kerosene emulsion to kill the young. The old bugs may be trapped by placing boards or shingles on the ground, which should be visited each morning and the bugs killed. Rept. 1908, p. 811.

Squash-Vine Borer—Larva tunnels in the base of the stem, causing decay. Cut slits lengthwise in the stem and kill borers. Cover the joints of the vine with earth so that new shoots may be formed to support the plant. Grow a few early plants for traps, and destroy them. The main crop should be planted rather late. Rept. 1908, p. 806.

Fungi.

Anthracnose—See Watermelon.

Storage Rots—Caused by various fungi that are best held in check by storage under conditions with minimum of heat and moisture.

Wilts—Cause leaves of the plants to wilt and then dry up, sometimes all of the vine thus suddenly dying. If a cross section of the stem shows a slight milky and sticky exudation, it is caused by bacteria that clod up the water ducts. Fungi in

similar trouble. Heavy manuring often develops these troubles. Spraying is of little value except as it may keep off insects which inoculate the plants with the bacteria. Use enough seed to allow for loss by wilt and pull up and destroy all the wilted vines as they appear. Rept. 1903, p. 359.

STRAWBERRY.

Insects.

Strawberry Sawfly—Larvae devour leaves. Spray with lead arsenate or hellebore.

Strawberry Weevil—Small snout beetles; females cut off blossom buds of staminate varieties when ovipositing. Plant pistillate varieties in part. Spray with lead arsenate.

Strawberry Crown Borer—Grub tunnels and feeds in crown of plant. Practice crop rotation. Burn over *infested field in fall*

Strawberry Flea Beetle—Adults eat holes through the leaves. Spray with lead arsenate.

Strawberry Leaf Roller—Larva rolls leaf and feeds inside. Spray with lead arsenate. Burn fields as soon as crop is harvested.

Strawberry Root Aphid—Sucks sap from leaves and roots killing plants. Set clean plants on land not infested. Spray with nicotine solution.

Strawberry Whitefly—Sucks sap from leaves. Underspray with nicotine solution.

Fungi.

Leaf Spot and **Blotch**—Cause conspicuous discolored spots, the former usually with whitish centers and purplish borders, and the latter with dark centers. Glen Mary sometimes severely injured by latter fungus. Renew the beds frequently. In the late fall or early spring cut off leaves with mower, add a little straw where necessary, and burn over beds. Spray with Bordeaux two or three times before blossoming, beginning last of April and repeating weekly, and once after blossoming is over. Repts. 1903, p. 360; 1914, p. 5.

Powdery Mildew—Covers leaves (more frequently on under, but more conspicuously, when present, on upper surface) with cobweb-like growth, often causing them to become stiff and curled inward. When necessary, this can probably be controlled with Bordeaux if sprayed before abundant. Rept. 1905, p. 276.

SWEET PEA.

Fungi.

Dampening Off—Rots off stem just below ground causing vines to turn yellow and finally die. Plant in well drained soil; place well rotted manure deep in ground below the seed; avoid excessive watering; spray base of vines and ground with Bordeaux; change beds if appearing yearly. Rept. 1907, p. 359.

SWEET POTATO.

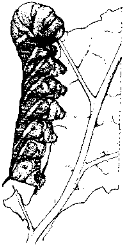
Insects.

Tortoise-Shell Beetles—Feed upon leaves. Spray with lead arsenate.

SYCAMORE.

Fungi.

Anthracnose—Kills young leaves in the spring; causes dead areas of irregular shape in tissues of older ones often following veins. If thought advisable to spray, use Bordeaux on the leaves as soon as showing and repeat when half grown.



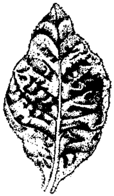
TOBACCO.

Insects.

Tobacco or **Tomato Horn-Worms**—Large green caterpillars with horn on the tail devour the leaves. Practice hand picking or spray the plants with lead arsenate. Rept. 1906, p. 269.

Flea Beetle—Adults eat holes through the leaves. Spray upper and under surface heavily with lead arsenate. Rept. 1906, p. 271.

Cut Worms—See Tomato.



Fungi, etc.

Calico—Causes the leaves to become irregularly mottled with a lighter green color and makes a very inferior tobacco. Frequently infected leaves finally show numerous, irregular, often merging, brown spots known as "rust." While calico is a physiological disease, due to injurious enzymes, it can be communicated to a healthy plant through contact with a very small amount of juice from a diseased plant. Care, therefore, is

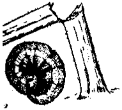
Never use tobacco water or tobacco stems on the seed beds. If calico shows in a seed bed, pull up all suspicious plants and those surrounding them. If troubled year after year, sterilize the seed beds or change them, and never make them on land used for tobacco the year before. When transplanting, wash the hands occasionally with soap and water. Repts. 1898, p. 242; 1899, p. 252; 1914, p. 357; Bull. 166, p. 10.

Dampening Off—Due to various fungi which rot off the seedlings close to the ground, and cause them to fall over. Keep air of beds as dry as consistent with good growth by care in watering and ventilating. If trouble starts in spots, take out all infected plants and refuse there.

Root Rot—Shows in seed beds by dwarfed "rosette" plants whose roots have been largely rotted off. Occasionally it does more or less damage in fields, especially in alkaline or water soaked soils; a short rotation is advisable in such cases. Sterilize seed beds with steam or treat with formalin (formula C). Repts. 1906, p. 342; 1907, p. 363.

TOMATO.

Insects.



Cut Worms—Eat off plant near ground or climb the plant and devour the leaves. Place around field poisoned bait or bran mash containing arsenic. Trap cut worms with small piece of board. Rept. 1906, p. 264; Bull. 190, p. 18.

Flea Beetle—See Potato or Tobacco.

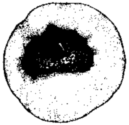
Stalk Borer—See Dahlia.

White-Fly—Sucks the sap from under side of leaves. Spray under side of leaves with soap and water. Fumigate greenhouse with hydrocyanic acid gas (1 oz. to 1,000 cubic ft.). Bull. 140 Rept. 1902, p. 148.

Fungi, etc.

Mosaic—Rept. 1908, p. 857. See Calico of Tobacco.

Leaf Spot—Produces on leaves and stems numerous, small, dark spots, often with white centers. Begin spraying with Bordeaux about the middle of July, making 3 or 4 applications at intervals of 10-14 days. This usually develops too late in the season here to cause serious damage.



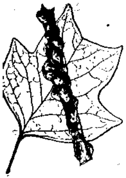
Point Rot—Causes the green fruit to rot at bloom end, showing a large, firm, dark-brown area. Claimed to be a physiological trouble. Frequently bad in very dry seasons. In greenhouses sub-irrigation is said to prevent it. Spraying, apparently, is of little value. Considerable difference exists in varieties as to susceptibility.

Scab—Occurs most commonly in greenhouses, covering under surface of leaves more or less abundantly with an olive-brown

Fungi.

y kills the tissue above. Spray with Bordeaux, before each of the later treatments.

s here chiefly in greenhouses; plants turn yellow p slowly; fungus may finally show on dead stem and nkish growth. Caused by fungus clogging ducts and off water supply to leaves; in young stage presence shown fa'blackened bundles where stems are cut across. Change soil if ppearing yearly; do not sow seeds from infected plants as they an carry the disease. Spraying of no value. Rept. 1903, p. 366.



TULIP TREE.

Insects.

Tulip Tree Scale—Large brown hemispherical soft scales on bark, sucking the sap, especially on lower branches. Spray with lime-sulphur when trees are dormant. Bull. 151; Rept. 1905, p. 239; 1912, p. 294.

TURNIP-RUTABAGA.

Insects.

Cut Worms—See Tomato.

Cabbage Maggot—See Cabbage.

Turnip Aphid—Green aphids on under side of leaves sucking the sap. Underspray with soap and water or nicotine solution. Rept. 1916, p. 98.

Fungi, etc.

Club Root—S... Cabbage.

Soft Rot—Causes an interior soft decay of roots, etc., of a variety of vegetables, such as turnips, salsify, parsnips, carrots, celery. Very wet seasons and imperfect storage conditions are usually the starting point of these troubles. Store under best possible conditions for keeping down heat and moisture. Keep contaminated refuse out of manure pile. Rept. 1914, p. 25.

Phoma Rot—Appears usually after storage, causing conspicuous, dry, sunken, subcircular, black spots scattered over roots. Fruiting pustules show as black dots. Store roots in cool dry place and not too deeply in the piles. Practice yearly rotation and keep refuse from manure pile. If necessary, use only artificial fertilizers. Rept. 1912, p. 355.

VIOLET.

Insects, etc.

Violet Sawfly—Larvae devour leaves. Spray with lead arsenate or hellebore.

Eelworms—Form galls on the roots. Plant in new soil or sterilize the old soil by steam. Add plenty of air-slaked lime to the soil. See Snapdragon.

Fungi.

Spot Disease—Shows as whitish round spots on the leaves. Spray field plants early in fall with Bordeaux. Select only best stock for greenhouse; remove *all* affected leaves before transplanting. When plants become established, spray again with Bordeaux. Be careful about watering plants, and, by proper ventilation and heat during September to November, keep atmosphere of house from ever becoming too moist.

WALNUT.

Insects.

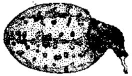
Walnut Caterpillar—Clusters of black caterpillars covered with whitish hairs strip the branches and finally the trees in August. Spray with lead arsenate. Clip off twigs when caterpillars are small, and kill by crushing. Rept. 1914, p. 191.

Walnut Weevil or **Curculio**—Adults feed at base of leaf stems. Larvae tunnel in new shoots and infest the fruit of Persian and Japanese walnuts. Spray with lead arsenate. Rept. 1912, p. 240.

Walnut Bud Moth—Larvae feed upon tender leaves and shoots, webbing them together. Spray with lead arsenate. Rept. 1912, p. 253.

WATERMELON.

Fungi,



Anthracnose—Shows as more or less abundant, dark, sunken spots or areas on the fruit. Also infects leaves in spots. Usually appears here too near end of season to cause sufficient injury to warrant spraying; spray also fails to adhere well to the fruit. Rotation and removal of rotting melons from field may possibly be helpful restrictive measures.

WHEAT.

Insects.

Army Worm—See Grass.

Hessian Fly—Maggots burrow in sheath of a leaf at base of stem, causing the stalks to turn yellow and die. Plant rather late—say about September 1st.

Wheat Midge—The fly lays eggs on the chaff and the maggots feed upon the developing kernels, so that the heads ripen early and produce no grain. Burn stubble before plowing. Plow infested fields deeply in the fall.

Green Bug or **Aphid**—Green aphids suck the sap from leaves Destroy in early fall all volunteer wheat and oats. Practice crop rotation.

Fungi.

Black Stem Rust—See Oats.

Leaf Rusts—Form small, dusty, orange-colored outbreaks on leaves, etc., and later darker and firmer mature stage. Several closely related species on barley, rye, and wheat but quite distinct from the Black Stem Rust. Attempts are being made to secure resistant varieties to these various grain rusts. No effective treatment.

Loose Smut—Destroys entire head turning it into a dusty olive-black mass that is dissipated in time. Severe hot water treatment partially effective. See Oats.

Stinking Smut—Fills the apparently scarcely changed seeds with a dusty mass of spores. Spores often found more or less abundantly in middlings and other feeds containing wheat, and their presence in amount indicates poor quality and may have some connection with complaint of injury to stock fed on these. Rept. 1909-10, p. 736.

Fungi.

y kill

befo

WILLOW.

s he **pillar**—See Elm.

up s **Maker**—See Poplar.

nki **Willow Curculio**—See Poplar.

off Large reddish aphids congregate on twigs in fall, and black sap. Spray with kerosene emulsion or nicotine solution.

app

Oyster-Shell Scale—See Apple.

Fungi.

Rusts—Occur on the leaves; similar in appearance and closel related to those on poplar, *q. v.* The alternate host for one specie is the larch and apparently there is another whose alternate hos is not yet determined. Rept. 1915, p. 450.

Prospective purchasers should write to these firms for catalogues and prices.

MANUFACTURERS OF SPRAYING MACHINES.

Aspinwall Manufacturing Co., Jackson, Mich. (Hand and power potato sprayers.)

Barnes Mfg. Co., Mansfield, Ohio. (Hand and power sprayers.)

Bateman Mfg. Co., Grenloch, N. J. (Iron Age sprayers for hand and power.)

Bean Spray Pump Co., Lansing, Mich.; San Jose, Calif. (Hand and power outfits.)

Brackett, Shaw & Lunt Co., Somersworth, N. H., 62 No. Washington St., Boston, Mass. (Hand and power outfits.)

Brown Co., E. C., Rochester, N. Y. (Compressed air, hand and power outfits.)

Church, Stephen B., Seymour, Conn., 64 Pearl St., Boston, Mass. (Power and hand sprayers.)

Cushman Sprayer Co., St. Joseph, Mo. (Power outfits.)

Dayton Manufacturing Co., 2240 East Third St., Dayton, Ohio. (Hand sprayers.)

Deming Co., Salem, Ohio. (Hand and power outfits.)

Douglas, W. & B., Middletown, Conn. (Hand and power pumps.)

Field Force Pump Co., Elmira, N. Y. (Hand and power pumps.)

Fitzhenry Guptill Co., 135 First St., East Cambridge, Mass. (Pow sprayers.)

Friend Mfg. Co., Gasport, N. Y. (Power and hand pumps.)

Goulds Mfg., Co., 58 Pearl St., Boston, Mass.; 16 Murray St., New Yor (Hand and power sprayers.)

Hardie Mfg. Co., Hudson, Mich.; Hagerstown, Md. (Hand and pow pumps.)

Humphryes Mfg. Co., Mansfield, Ohio. (Hand and power pumps.)

Hurst Mfg. Co., H. L., Greenwich, Ohio.

Leggett & Brother, 301 Pearl St.,New York. (Hand and power dustir machines.)

Myers & Brother, F. E., Ashland, Ohio. (Hand and power pumps.)

Niagara Sprayer Co., Middleport, N. Y. (Dusting machines.)

Rumsey Pump Co., Ltd., 49 Federal St., Boston, Mass. (Hand an power pumps.)

Spramotor Co., 107-109 Erie St., Buffalo, N. Y. (Hand and pow outfits.)

MANUFACTURERS OF INSECTICIDES AND FUNGICIDES.

Blanchard Co., Jas. A., Hudson Terminal Bldg., 30 Church St., New York. (Insecticides and fungicides.)

Bowker Insecticide Co., 43 Chatham St., Boston, Mass., 1011 Fidelity Bldg., Baltimore, Md. (Insecticides and fungicides.)

Devoe & Raynolds Co., Inc., 101 Fulton St., New York. (Arsenical poisons.)

Frost Insecticide Co., 20 Mill St., Arlington, Mass. (Spray chemicals and apparatus.)

General Chemical Co., 25 Broad St., New York. (General insecticid and fungicides.)

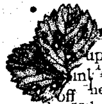
Grasselli Chemical Co., 80 Maiden Lane, New York. (Insecticides an fungicides.)

Hemingway & Co., Inc., Bound Brook, N. J. (Arsenical poisons.)

Interstate Chemical Co., 12-20 Bay View Ave., Jersey City, N. J. (I secticides and fungicides.)

Kentucky Tobacco Product Co., Louisville, Ky. (Nicotine solution.)

Fungi. [illegible]



[illegible] L., 100 William St., New York. (Arsenical poisons.)
[illegible] 301 Pearl St., New York. (Insecticides and fungicides.)
[illegible] Mfg. Co., Line St., Camden, N. J. (Insecticides and [illegible])
[illegible] Chemical Co., 33 Broad St., Boston, Mass. (Lead arsenate.)
[illegible] Sablor and Chemical Works, Selling Agents for Taylor Chemical [illegible], 59th St. & 11th Ave., New York. (Carbon disulphide.)
[illegible] agara Sprayer Co., Middleport, N. Y. (Dusting materials.)
Pratt Co., B. G., 50 Church St., New York. (Miscible oils.)
Riches, Piver & Co., 30 Church St., New York. (Arsenical poisons.)
Robertson Co., The J. T., 147 Richmond Ave., Syracuse, N. Y. (Miscib[le] oils.)
Roessler & Hasslacher Chemical Co., 100 William St., New York. (C[y]anide.)
Sherwin-Williams Co., 601 Canal Road, Cleveland, Ohio. (Lime-sulph[ur] and arsenical poisons.)
Thum Co., O. & W., Grand Rapids, Mich., 15 India St., Boston, Mas[s]. (Tanglefoot.)
Vreeland Chemical Mfg. Co., 50 Church St., New York. (Insecticid[es] and fungicides.)

CONNECTICUT DEALERS IN SPRAYING SUPPLIES.

Dealers in spraying materials can usually be found in each town. Some of the larger firms are mentioned below.

Apothecaries Hall Co., 24 Benedict St., Waterbury. (Wholesale druggists.)
Barnes Bros., Yalesville. (Insecticides and fungicides.)
Cadwell & Jones, 1084 Main St., Hartford. (Pumps, insecticides and fungicides.)
Grasselli Chemical Co., River St., New Haven. (Insecticides and fungicides.)
Henry & Son, W. A., Blue Hills Farm, Wallingford. (Friend sprayers.)
Jewell, Harvey, Cromwell (Agent for Hardie hand and power sprayers
Leete Co., The Chas. S., 299 State St., New Haven. (Wholesale druggists
Lightbourn & Pond Co., 39 Broadway, New Haven. (Pumps, insect[i]cides and fungicides.)
Platt Co., The Frank S., 845-855 Dixwell Ave., New Haven. (Pump[s], insecticides and fungicides.)
Sisson Drug Co., 729 Main St., Hartford. (Spraying machines a[nd] insecticides.)
Whittlesey Co., The Chas. W., 259-271 State St., New Haven. (Whol[e]sale druggists.)

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 200 DECEMBER, 1917

BEING THE

Twenty-Second Report

ON

Food Products

AND

Tenth Report on Drug Products

By JOHN PHILLIPS STREET

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Twenty-Second Report on Food Products and Tenth Report on Drug Products, 1917.

BY JOHN PHILLIPS STREET.*

As the prevalence of food adulteration decreases, the food work done by the Station on its own initiative has less to do with that feature. During recent years we have paid more attention to the nutritive value of foods, especially those which are either new to this state or the analyses of which have not yet appeared in our published reports. Eventually these reports will contain the analyses of practically all foods sold in Connecticut under distinctive brand names.

Aside from investigations of this kind, during the past year the Station has devoted considerable time to a study of bread. This has dealt with the influence of certain " yeast foods " or "bread improvers," as well as a study of variations in the weights of loaves of bread due to inequalities in the working of the molding machines and scaling operations at the bakeries, and also of variations due to the drying out of the loaves between the time of baking and their purchase by the consumer. The methods of fat determination in bread have also been reviewed, and losses in fat heretofore attributed to losses during the baking process have been shown to be due almost entirely to failure of the official method to extract the fat.

The laboratory also has studied in some detail the method of drying vegetables by means of a current of unheated air from an electric fan, and analyses of 18 dried vegetables are given in this report.

* The analytical work herein reported was done mainly by the writer's assistants, E. M. Bailey, C. B. Morison and C. E. Shepard. Especial credit is due to Mr. Morison for his painstaking work in connection with the difficult analysis of the drugs from physicians' stocks.

Unfortunately the laboratory's work on the composition of proprietary medicines has been interrupted this year. However, the chief chemist has prepared a book entitled "The Composition of Certain Patent and Proprietary Medicines," which has been published by the American Medical Association. This compilation gives the analyses of 2800 brands of these medicines, and should prove of use to physicians, pharmacists, inspection officials and to the general public.

In addition to 536 samples collected by our own agent, 678 samples collected by the Dairy and Food Commission were examined. These were chiefly milk, vinegar, Hamburg steak, sausage, physicians' drugs and toilet preparations. Of the 678 samples, 334 were found to be adulterated or below standard, 118 of these, however, being milks which were deficient only in solids-not-fat.

One hundred and forty samples sent by private individuals were tested, 44 of these samples being adulterated or below standard.

During the past year much of the time of the chief chemist has been occupied with work in connection with food and drug control in other allied organizations. He has served as a member of the Joint Committee on Food Definitions and Standards, Associate Editor of the Journal of the Association of Official Agricultural Chemists, expert on diabetic foods for the Council of the American Medical Association, Vice Chairman of the Section of Food and Drugs, Chairman of the Committee on Nostrums, and Director of the American Public Health Association, Secretary of the New England Association of Food Inspection Officials, and Chairman of the Committee of the American Association of Dairy, Food and Drug Officials on Co-operation with the Hoover Food Administration.

CANNED BEANS.

Sixty-two samples of canned beans were analyzed, including 5 of red kidney, 23 of lima and 34 of string and wax beans. The brand names of these samples are given below:

Red Kidney Beans.

7995. Sunbeam Pure Food Kidney Beans, Austin, Nichols and Co.,

8099. Oak Orchard Brand Red Kidney Beans, Batavia Canning Co., Batavia, New York.

8010. Burt Olney's Red Kidney Beans, The Burt Olney Canning Co., Oneida, N. Y.

8084. Oneida Chief Brand Red Kidney Beans, The Burt Olney Canning Co., Oneida, N. Y.

8105. Van Camp's Red Kidney Beans, The Van Camp Packing Co., Indianapolis, Ind.

Lima Beans.

8034. Medium Lima Beans, Acker, Merrall and Condit Co., New York.

8090. Valley Field Fresh Lima Beans, Austin, Nichols and Co., New York.

8022. Gold Rock Brand Small Tender Lima Beans, A. F. Beckman and Co., New York.

8049. Early Autumn Brand Lima Beans, Est. A. Brakeley, Bordentown, N. J.

7999. Luxury Lima Beans, Joseph Brakeley, Freehold, N. J.

8071. B. and M. Lima Beans (prepared by cooking dried lima beans), Burnham and Morrill, Portland ,Me.

8042. Essie Brand Fancy Quality Lima Beans, James Butler, New York.

8104. Lima Beans, Curtice Brothers Co., Rochester, N. Y.

8080. Davisco Brand Lima Beans, F. H. Davis and Co., New London, Conn.

8095. Harrison Brand Lima Beans Standard Quality, Lewis De Groff and Son, New York.

8082. Aurora Brand Fancy Medium Green Lima Beans, Geneva Preserving Co., Geneva, N. Y.

8075. Gold Leaf Green Lima Beans, Granger and Co., Buffalo, N. Y.

8001. Royal Seal Brand Soaked Lima Beans, Granger and Co., Buffalo, N. Y.

8096. Green Mountain Brand Lima Beans (prepared from dried lima beans), Green Mountain Packing Co., Portland, Me.

8009. Webster's Best Brand Lima Beans, The Lord-Webster Co., Baltimore, Md.

8094. Country Club Brand Lima Beans (prepared from dried lima beans), quality unsurpassed, Portland Packing Co., Portland, Me.

8086. Hart Brand Little Quaker Lima Beans, W. R. Roach and Co., Hart, Mich.

8100. Monroe Brand Lima Beans (equal in quality to any so-called Extra Standards), Rochester Preserving Co., Rochester, N. Y.

8103. Portia Brand Lima Beans, Seeman Bros., New York.

8031. White Rose Brand Small Lima Beans, Seeman Bros., New York.

8077. The Famous Royal Scarlet Brand Small Lima Beans, R. C. Williams and Co., New York.

8011. Brownie Brand Lima Beans (prepared from dried lima beans), D. E. Winebrenner Co., Hanover, Pa.

8047. Empire Brand Green Lima Beans, First Quality, Winters and Prophet Canning Co., Mount Morris, N. Y.

String and Wax Beans.

8033. Noreca Brand Extra Standard Quality String Beans, Acker, Merrall and Condit Co., New York.

8091. Meadow Brook Brand Cut Golden Wax Beans, The Burt Olney Canning Co., Oneida, N. Y.

8069. Oneida Chief Brand Cut Golden Wax Beans, The Burt Olney Canning Co., Oneida, N. Y.

8068. Oneida Chief Brand Refugee Beans, The Burt Olney Canning Co., Oneida, N. Y.

8043. Essie Brand Fancy Quality Stringless Beans, James Butler, New York.

8093. Health Brand Cut Wax Beans, Lewis De Groff and Son, New York.

8079. Shield Brand String Beans, J. S. Farren and Co., Baltimore, Md.

8007. Eagle Brand Refugee Beans, Fort Stanwix Canning Co., Rome, N. Y.

8076. Waldorf Brand Tiny Golden Wax Beans, Fort Stanwix Canning Co., Rome, N. Y.

7996. Fredonia Beauty Brand Fancy Refugee Beans, Fredonia Preserving Co., Fredonia, N. Y.

8074. Royal Seal Brand Cut Golden Wax Beans, Granger and Co., Buffalo, N. Y.

7994. Royal Seal Brand Cut Golden Wax Beans, Granger and Co., Buffalo, N. Y.

8081. Royal Seal Brand Cut String Beans, Granger and Co., Buffalo, N. Y.

8087. Iona Brand String Beans, The Great Atlantic and Pacific Tea Co., Jersey City, N. J.

7997. Sultana Brand String Beans, The Great Atlantic and Pacific Tea Co., Jersey City, N. J.

8050. Green Mountain Brand Cranberry Stringless Beans, Green Mountain Packing Co., Portland, Me.

8097. Helmet Brand Golden Wax Beans, The E. S. Kibbe Co., Hartford, Conn.

8098. Our Choice Cut Golden Wax Beans, Medina Canning Co., Medina, N. Y.

8101. Forest King Brand Cut Refugee Beans, W. H. Osborn Co., Honeoye Falls, N. Y.

7993. Silver Key Brand Golden Wax Beans, Standard Quality, Oswego Preserving Co., Oswego, N. Y.

8085. Hart Brand Little Dot String Beans Extra Quality, W. R. Roach and Co., Hart, Mich.

8045. Bridal Brand Cut Wax Beans, Thos. Roberts and Co., Philadelphia, Pa.

8014. Golden Wedding Cut Refugee Beans, Fine Quality, Rochester Preserving Co., Rochester, N. Y.

8032. White Rose Brand String Beans, Seeman Bros., New York.

8102. White Rose Yellow Wax Beans, Seeman Bros., New York.

8000. Extra Standard Stringless Beans, B. F. Shriver Co., Union Mills, Md.

8023. Epicure Cut Stringless Beans, Extra Quality, John S. Sills and Sons, New York.

8089. Hermitage Brand Extra Stringless Refugee Beans, Our Finest Quality, Stoddard, Gilbert and Co., New Haven.

8083. Hatchet Brand Extra Fine Refugee Beans, The Twitchell-Champlin Co., Portland, Me.

8106. Economy Brand Refugee String Beans, R. C. Williams and Co., New York.

8016. The Famous Royal Scarlet Brand Stringless Refugee Beans, R. C. Williams and Co., New York.

8070. Lusitania Brand String Beans, R. C. Williams and Co., New York.

8012. Conewago Brand Cut Refugee String Beans, D. E. Winebrenner Co., Hanover, Pa.

8046. Empire Brand Golden Wax Beans First Quality, Winters and Prophet Canning Co., Mount Morris, N. Y.

Tables I and II give the results of the physical examination of these samples, while Tables III and IV show the composition of both the drained beans and the separated liquor.

Physical Examination.

Proportion of Beans and Liquor. After weighing the sealed cans, they were opened and the liquor separated from the beans by draining through a colander.

The weight of drained beans in the red kidney beans ranged from 413 to 430 gms; and that of the liquor from 178 to 205 gms. The liquor made up from 29.7 to 33.1 per cent. of the total weight of the can contents.

In the lima beans the variations in amounts of beans and liquor were much greater, the beans ranging from 297 to 413 gms.; and the liquor from 184 to 284 gms. The liquor made up from 31.3 to 48.9 per cent. of the total weight of the can contents, 9 of the 23 samples containing 40 per cent. or more of liquor.

The variations with the wax and string beans were likewise large. The weight of drained beans ranged from 240 to 376 gms., and that of the liquor from 203 to 323 gms. The liquor made up from 37.7 to 57.4 per cent. of the total net weight, 14 of the 34 samples containing 45 per cent. or more of liquor.

TABLE I.—RED KIDNEY AND LIMA BEANS.

Station No.	Brand.	Weight of: Can and contents.	Weight of: Beans and liquor.	Weight of: Drained beans.	Weight of: Liquor.	Weight of: Per cent. liquor.	Weight of Contents: Claimed.	Weight of Contents: Found.	Cost per can.	Cost per lb. drained beans.	Size of beans.	Top of can above level of contents.
	Red Kidney Beans.	gms.	gms.	gms.	gms.		oz.	oz.	cts.	cts.		in.
7995	Sunbeam	728	619	414	205	33.1	20	21.9	10	10.9	...	1/4
*8099	Oak Orchard	699	591	413	178	30.1	19	20.9	10	10.9	...	3/8
8010	Bert Olney	718	615	427	188	30.6	20	21.7	10	10.7	...	9/16
8084	Oneida Chief	715	612	430	182	29.7	20	21.6	15	15.8	...	5/8
*8105	VanCamp	719	613	428	185	30.2	20	21.7	15	15.9	...	3/8
	Lima Beans.											
8034	Acker, Merrall & Condit	694	597	369	228	38.2	19	21.1	13	16.0	small	7/16
8090	Austin, Nichols & Co.	701	601	391	210	34.9	19	21.2	10	11.6	med.	7/16
*8022	Beckmann	697	577	345	232	40.2	19	20.4	15	19.7	"	1/4
8049	A. Brakeley	700	603	374	229	38.0	19	21.3	12	14.5	"	1/2
7999	J. Brakeley	697	598	413	185	31.3	19	21.1	12	13.2	"	7/16
8071	Burnham & Morrill	697	598	386	212	35.5	20	21.1	13	15.3	large	9/16
8042	Butler	688	588	338	250	42.5	19	20.8	15	20.2	small	9/16
8104	Curtice Bros.	679	578	363	215	37.3	20	20.3	12	15.0	med.	11/16
8080	Davis	694	595	384	211	35.5	20	21.0	15	17.7	small	7/16
*8095	De Groff	683	581	297	284	48.9	..	20.5	10	15.2	med.	1/4
8082	Geneva Pres. Co.	696	596	366	230	38.6	20	21.1	15	18.6	"	7/16
8075	Granger (Golf Leaf)	707	611	360	251	41.1	20	21.6	15	18.9	"	1/2
*8001	Granger (Royal Seal)	708	596	345	251	42.1	20	21.1	10	13.1	large	5/16
*8096	Green Mountain	711	607	399	208	34.3	20	21.4	13	14.7	"	1/4
8009	Webster's	689	598	355	243	40.6	20	21.1	12	15.4	med.	9/16
8094	Portland Pack. Co.	690	587	397	190	32.4	20	20.7	10	11.4	"	11/16
8086	Roach	715	615	369	246	40.0	20	21.7	17	20.9	small	3/8
8100	Rochester Pres. Co.	706	604	383	221	36.6	20	21.3	15	17.8	med.	1/2
8103	Seeman Bros. (Portia)	690	596	371	225	37.7	19	21.0	13	15.8	"	1/2
8031	Seeman Bros. (White Rose)	697	598	351	247	41.3	20	21.1	15	19.4	small	7/16
8077	Williams	688	592	391	201	34.0	20	20.9	15	17.4	"	9/16
8011	Winebrenner	686	590	347	243	41.1	20	20.8	10	13.1	large	1/2
*8047	Winters & Prophet	667	559	375	184	32.9	20	19.7	15	18.2	small	1/2

* In sanitary can.

From these data it appears that on the average the canned red kidney beans contain the least free liquor and the wax and string beans the most. The cut wax and string beans contained on the average 40.9 per cent. of free liquor, while the whole beans of this kind averaged 46.8 per cent.

Net Weight of Can Contents. All the samples but one bore a statement of net weight. Only one sample of lima and three of wax and string beans showed slight deficiencies of from 0.2 to 0.8 oz.

TABLE II.—WAX AND STRING BEANS.

Station No.	Brand.	Weight of: Can and contents.	Weight of: Beans and liquor.	Weight of: Drained beans.	Weight of: Liquor.	Weight of: Per cent. liquor.	Weight of Contents: Claimed.	Weight of Contents: Found.	Cost per can.	Cost per lb. drained beans.	Size of beans.	Whole or cut.	Top of can above level of contents.
		gms.	gms.	gms.	gms.		oz.	oz.	cts.	cts.			in.
*8033	Noreca String	695	589	324	265	45.2	19	20.8	12	16.8	med.	whole	1/16
8091	Meadow Brook Wax	675	576	331	245	41.5	19	20.3	15	20.5	"	cut	7/16
8069	Oneida Chief Wax	683	585	344	241	41.2	18	20.6	15	19.8	"	"	3/8
8068	Oneida Chief Refugee	678	576	319	257	44.6	19	20.4	15	21.2	"	whole	5/8
*8043	Essie Stringless	686	581	337	244	42.0	19	20.5	17	22.9	small	"	1/8
*8093	Health Wax	672	565	331	234	41.4	19	19.9	15	20.5	large	cut	1/4
8079	Shield String	651	555	266	289	52.1	20	19.2	10	17.0	"	whole	9/16
*8007	Eagle Refugee	686	583	333	250	42.9	19	20.6	15	20.5	small	"	3/16
*8076	Waldorf Wax	684	582	280	302	51.9	19	20.5	15	24.3	"	"	3/16
*7996	Fredonia Refugee	680	573	346	227	39.6	20	20.2	15	19.7	"	"	1/4
*8074	Royal Seal Wax	669	568	344	224	39.4	19	20.0	10	13.2	large	cut	1/4
*7994	Royal Seal Wax	691	583	304	279	47.9	19	20.6	10	14.9	"	"	3/16
8081	Royal Seal String	684	577	345	232	40.2	19	20.3	12	15.7	med.	"	1/4
8087	Iona String	667	563	240	323	57.4	19	19.8	10	18.8	large	whole	9/16
*7997	Sultana String	686	577	356	221	38.3	19	20.4	8	10.2	"	cut	3/16
*8050	Green Mountain Stringless	691	594	357	237	40.0	19	21.0	13	16.5	"	"	1/16
*8097	Helmet Wax	699	593	311	282	47.6	19	21.0	15	21.8	small	whole	7/8
*8098	Medina Wax	678	572	341	231	40.4	19	20.3	10	13.3	med.	cut	1/4
*8101	Forest King Refugee	674	568	325	243	42.8	19	20.1	15	21.1	"	"	1/4
*7993	Silver Key Wax	645	539	336	203	37.7	19	18.7	13	17.6	large	whole	1/2
8085	Hart String	666	565	376	289	51.1	19	19.9	20	24.1	small	"	5/16
*8045	Bridal Wax	687	582	345	237	40.7	19	20.5	13	17.0	large	cut	3/16
8014	Golden Wedding Refugee	674	568	328	240	42.3	19	20.1	10	13.8	small	"	7/16
*8032	White Rose String	675	567	305	262	46.2	19	20.0	16	23.9	"	whole	1/4
*8102	White Rose Wax	684	580	334	246	42.4	19	20.4	15	20.3	"	"	1/4
8000	Shriver Stringless	663	561	304	257	45.8	20	19.8	10	15.0	mix.	"	1/2
8023	Epicure Stringless	683	575	351	224	39.0	20	20.3	15	19.4	large	cut	5/16
*8089	Hermitage Stringless	661	555	296	259	46.7	19	19.6	15	22.9	med.	whole	5/16
*8083	Hatchet Refugee	678	579	296	283	48.9	19	20.5	20	30.5	small	"	1/8
*8106	Economy String	668	567	274	293	51.7	19	20.0	12	19.8	large	"	3/16
*8016	Royal Scarlet Stringless	677	564	266	298	52.8	19	19.9	15	25.5	small	"	5/16
*8070	Lusitania String	659	562	287	275	48.9	19	19.8	12	19.0	large	"	5/16
*8012	Conewago String	687	581	360	221	38.0	20	20.5	10	12.6	"	cut	3/16
8046	Empire Wax	686	581	343	238	41.0	19	20.5	15	19.8	small	whole	3/8

* In sanitary can.

Fill of Cans. The distance between the level of the can contents and the top of the can ranged from 1/4 to 9/16 in. in the red kidney beans, from 1/4 to 11/16 in. in the lima beans, and from 1/16 to 5/8 in. in the wax and string beans. Nineteen of the 62 samples showed an air space of 1/2 in. or over.

Cost per Can. The cost of the red kidney beans ranged from 10 to 15 cents, that of the limas from 10 to 17 cents, and that of the wax and string beans from 8 to 20 cents per can.

TABLE III.—ANALYSES OF RED KIDNEY AND LIMA BEANS.

Station No.	Drained Beans. Water.	Total ash.	Protein. (Nx6.25.)	Fiber.	Nitrogen-free extract.	Ether extract.	Sodium chlorid.	Bean ash.	Liquor. Water.	Solids.	Total ash.	Sodium chlorid.	Bean ash.	Acidity. cc. N/10 NaOH per 100 cc.
Red Kidney.														
7995	70.14	1.42	7.27	1.24	19.38	0.55	0.51	0.91	88.06	11.94	1.78	0.99	0.79	24.0
8099	71.22	1.42	6.38	1.28	19.17	0.53	0.46	0.96	88.61	11.39	1.82	0.99	0.83	24.6
8010	71.16	1.37	7.51	1.28	18.18	0.50	0.44	0.93	86.84	13.16	1.52	0.71	0.81	28.8
8084	71.27	1.39	6.71	1.26	18.84	0.53	0.66	0.73	86.26	13.74	1.56	0.70	0.86	32.6
8105	70.77	1.37	7.52	1.34	18.49	0.51	0.46	0.91	87.69	12.31	1.74	1.01	0.73	22.2
Ave.	**70.91**	**1.40**	**7.08**	**1.28**	**18.81**	**0.52**	**0.51**	**0.89**	**87.49**	**12.51**	**1.68**	**0.88**	**0.80**	**26.4**
Lima.														
8034	77.07	1.35	5.34	1.41	14.45	0.38	0.69	0.66	93.63	6.37	1.79	1.10	0.69	16.6
8090	72.92	1.55	5.87	1.42	17.95	0.29	0.65	0.90	91.53	8.47	2.00	1.05	0.95	22.4
8022	74.84	1.79	5.75	1.46	15.87	0.29	1.17	0.62	92.86	7.14	2.30	1.70	0.60	15.4
8049	74.46	1.43	5.92	1.57	16.30	0.34	0.66	0.77	93.67	6.33	1.73	0.94	0.79	17.2
7999	74.25	1.49	6.25	1.46	16.25	0.30	0.78	0.71	92.82	7.18	1.86	1.01	0.85	23.4
8071	74.45	1.45	5.97	1.61	16.20	0.32	0.63	0.82	88.86	11.14	1.68	0.81	0.87	22.4
8042	77.23	1.45	5.60	1.70	13.64	0.38	0.70	0.75	94.52	5.48	1.72	1.07	0.65	13.4
8104	71.20	1.66	7.86	1.78	17.19	0.31	0.55	1.11	91.43	8.57	1.93	1.09	0.84	18.0
8080	75.63	1.52	5.91	1.46	15.04	0.44	0.77	0.75	92.88	7.12	1.74	1.01	0.73	15.8
8095	75.11	1.01	5.38	1.41	16.80	0.29	0.41	0.60	93.77	6.23	1.25	0.71	0.54	14.6
8082	74.34	1.55	5.88	1.71	16.16	0.36	0.73	0.82	94.11	5.89	1.92	1.09	0.83	19.2
8075	74.11	1.54	6.24	1.64	16.05	0.42	0.66	0.88	91.47	8.53	1.67	1.02	0.65	16.4
8001	72.18	1.43	5.94	1.70	18.32	0.43	0.72	0.71	88.94	11.06	1.74	0.93	0.79	20.6
8096	71.87	1.59	6.14	1.67	18.38	0.35	0.32	1.27	86.61	13.39	1.91	1.14	0.77	23.[illegible]
8009	73.30	1.73	6.12	1.50	17.03	0.32	1.07	0.66	92.12	7.88	2.20	1.41	0.79	18.[illegible]
8094	72.68	1.37	6.94	1.49	17.01	0.51	0.43	0.94	90.95	9.05	1.57	0.81	0.76	19.[illegible]
8086	76.92	1.60	5.61	1.63	13.79	0.45	0.76	0.84	94.43	5.57	1.82	1.21	0.61	10.[illegible]
8100	*74.99*	*1.75*	*6.14*	*1.33*	*15.46*	*0.33*	*0.86*	*0.89*	*91.21*	*8.79*	*2.04*	*1.37*	*0.67*	*18.[illegible]*
8103	72.25	1.53	5.84	1.62	18.36	0.40	0.66	0.87	92.27	7.73	1.89	1.11	0.78	19.4
8031	76.34	1.45	5.39	1.74	14.73	0.35	0.76	0.69	94.60	5.40	1.73	1.04	0.69	16.[illegible]
8077	75.61	1.43	5.68	1.45	15.41	0.42	0.64	0.79	91.84	8.16	1.69	0.92	0.77	19.[illegible]
8011	72.38	1.52	6.74	1.69	17.27	0.40	0.76	0.76	90.96	9.04	1.90	1.03	0.87	22.[illegible]
8047	75.06	1.11	5.28	1.54	16.59	0.42	0.61	0.50	92.95	7.05	1.61	1.02	0.59	14.[illegible]
Ave.	**74.31**	**1.49**	**5.99**	**1.57**	**16.27**	**0.37**	**0.69**	**0.80**	**92.11**	**7.89**	**1.81**	**1.07**	**0.74**	**18.[illegible]**

Cost per Pound of Drained Beans. The red kidney beans cost from 10.9 to 15.9 cents per pound of drained beans, the limas from 11.6 to 20.9 cents, and the wax and string beans from 10.2 to 30.5 cents. These wide variations in cost are influenced, of course, both by the cost per can and the proportion of drained beans present, and clearly indicate the possibilities of economy in a wise choice of brands. The apparently cheap brands are by no means always the most economical purchase, for very often their low cost is due to the relatively large amount of liquor sold with them.

TABLE IV.—ANALYSES OF WAX AND STRING BEANS.

Station No.	Drained Beans. Water.	Total ash.	Protein. (Nx6.25).	Fiber.	Nitrogen-free extract.	Ether extract.	Sodium chlorid.	Bean ash.	Liquor. Water.	Solids.	Total ash.	Sodium chlorid.	Bean ash.	Acidity, cc N/10 NaOH per 100 cc.
8033	92.27	1.76	1.29	0.90	3.68	0.10	1.37	0.39	95.52	4.48	1.72	1.47	0.25	12.0
8091	93.59	1.03	1.16	0.86	3.28	0.08	0.76	0.27	97.05	2.95	1.01	0.83	0.18	6.7
8069	93.88	1.02	1.28	0.81	2.93	0.08	0.53	0.49	97.15	2.85	0.93	0.69	0.24	7.8
8068	93.77	1.25	1.18	0.77	2.94	0.09	0.84	0.41	96.72	3.28	1.15	0.88	0.27	7.4
8043	93.23	1.18	1.50	0.87	3.13	0.09	0.77	0.41	96.35	3.65	1.10	0.83	0.27	11.2
8093	90.42	1.67	1.43	1.26	5.10	0.12	1.30	0.37	96.07	3.93	1.70	1.42	0.28	9.6
8079	91.77	1.47	1.26	0.94	4.41	0.15	1.09	0.38	96.10	3.90	1.35	1.11	0.24	13.2
8007	93.60	1.30	1.25	0.81	2.96	0.08	0.92	0.38	96.53	3.47	1.25	1.00	0.25	10.8
8076	93.51	1.50	1.21	0.80	2.90	0.08	1.12	0.38	96.61	3.39	1.45	1.20	0.25	7.6
7996	93.01	1.29	1.39	0.87	3.35	0.09	0.83	0.46	96.61	3.31	1.14	0.86	0.28	10.0
8074	91.92	0.85	1.05	0.92	5.18	0.08	0.61	0.24	95.74	4.26	0.82	0.55	0.27	8.4
7994	89.76	1.46	2.07	1.00	5.63	0.08	1.13	0.33	94.32	5.68	1.43	1.20	0.23	9.2
8081	93.59	1.41	1.30	0.94	2.66	0.10	0.82	0.59	96.75	3.25	1.11	0.87	0.24	12.0
8087	90.81	1.73	1.55	1.21	4.56	0.14	1.31	0.42	96.41	3.59	1.77	1.48	0.29	7.9
7997	93.43	1.23	1.26	0.86	3.14	0.08	0.85	0.38	96.74	3.26	1.15	0.90	0.25	8.8
8050	91.20	1.48	1.41	1.07	4.73	0.11	1.11	0.37	95.10	4.90	1.47	1.19	0.28	11.4
8097	93.55	1.36	1.51	0.82	2.67	0.09	0.94	0.42	96.74	3.26	1.25	1.01	0.24	7.4
8098	92.37	1.14	1.53	0.97	3.89	0.10	0.75	0.39	96.89	3.11	1.08	0.81	0.27	8.8
8101	94.09	0.74	1.16	0.88	3.05	0.08	0.38	0.36	97.36	2.64	0.65	0.41	0.24	8.8
7993	90.81	1.38	1.96	1.28	4.45	0.12	0.93	0.45	95.86	4.14	1.42	1.05	0.37	16.0
8085	92.87	1.17	1.70	0.91	3.24	0.11	0.71	0.46	96.54	3.46	1.07	0.76	0.31	7.9
8045	91.97	1.14	1.38	1.06	4.37	0.08	0.79	0.35	96.56	3.44	1.10	0.85	0.25	9.0
8014	93.46	1.17	1.16	1.01	3.11	0.09	0.79	0.38	96.91	3.09	1.05	0.83	0.32	9.6
8032	94.54	0.94	1.15	0.75	2.52	0.10	0.58	0.36	97.35	2.65	0.85	0.61	0.24	7.6
8102	93.73	1.15	1.30	0.84	2.90	0.08	0.75	0.40	96.82	3.18	1.07	0.81	0.26	7.3
8000	92.06	1.02	1.31	0.96	4.53	0.12	0.61	0.41	95.95	4.05	0.96	0.67	0.29	10.4
8023	93.64	1.58	1.02	0.81	2.87	0.08	1.25	0.33	96.23	3.77	1.56	1.34	0.22	15.6
8089	93.24	1.29	1.21	0.89	3.26	0.11	0.91	0.38	96.07	3.93	1.29	1.04	0.25	9.8
8083	94.16	1.27	1.17	0.78	2.53	0.09	0.84	0.43	96.93	3.07	1.18	0.99	0.19	8.0
8106	93.40	1.37	1.19	0.80	3.15	0.09	1.04	0.33	96.55	3.45	1.36	1.15	0.21	8.2
8016	94.05	1.10	1.29	0.80	2.67	0.09	0.75	0.35	97.15	2.85	1.02	0.82	0.20	8.8
8070	92.37	1.00	1.40	0.97	4.13	0.13	0.62	0.38	96.98	3.02	0.95	0.70	0.25	9.8
8012	93.76	1.27	1.18	0.88	2.81	0.10	0.95	0.32	96.71	3.29	1.25	1.03	0.22	10.4
8046	93.35	1.02	1.30	0.81	3.44	0.07	0.65	0.38	96.57	3.43	0.99	0.69	0.30	9.8
Ave.	**92.85**	**1.26**	**1.34**	**0.92**	**3.53**	**0.10**	**0.87**	**0.39**	**96.47**	**3.53**	**1.20**	**0.95**	**0.25**	**9.6**

CHEMICAL COMPOSITION.

Inasmuch as the liquor accompanying the beans is usually thrown away, the composition of the beans themselves is of chief interest.

The following tabulation shows the maximum, minimum and average amounts of food ingredients contained in the different classes of beans:

	Red Kidney.			*Lima.*			*Wax and String.*		
In drained beans:	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
Water	71.27	70.14	70.91	77.23	71.20	74.31	94.54	89.76	92.85
Protein	7.52	6.38	7.08	7.86	5.28	5.99	2.07	1.02	1.34
Fiber	1.34	1.24	1.28	1.78	1.33	1.57	1.28	0.75	0.92
Nitrogen-free extract	19.38	18.18	18.81	18.38	13.64	16.27	5.63	2.52	3.53
Ether extract	0.55	0.50	0.52	0.51	0.29	0.37	0.15	0.07	0.10
Ash, salt-free	0.96	0.73	0.89	1.27	0.50	0.80	0.59	0.24	0.39
Sodium chlorid	0.66	0.44	0.51	1.17	0.32	0.69	1.37	0.38	0.87
In liquor:									
Water	88.61	86.26	87.49	94.60	86.61	92.11	97.36	94.32	96.47
Ash, salt-free	0.86	0.73	0.80	0.93	0.54	0.74	0.37	0.18	0.25
Sodium chlorid	1.01	0.70	0.88	1.70	0.71	1.07	1.48	0.41	0.95

The brands of red kidney beans showed a remarkably uniform composition. On the average they contained about 29 per cent. of solids, one-fourth of which was protein, and the remaining three-fourths chiefly carbohydrates. The proportion of ether extract (fat) is almost negligible.

The lima beans on the average contained somewhat less solids than the red kidney beans, but the relative proportions of protein and carbohydrates were about the same. Five brands labeled "soaked beans" contained on the average about 2 per cent. more solids than the other brands, three-fourths of which was carbohydrates and one-fourth protein. Consequently these soaked beans contained somewhat more nutriment than the unsoaked varieties, but of course with less tenderness and flavor. On the other hand the soaked beans were considerably cheaper, costing on the average 11.2 cents per can and 13.5 cents per pound of drained beans, against 13.7 and 17.0 cents per pound, respectively, in the other brands.

The wax and string beans supply much less nutriment than either red kidney or lima beans, containing only about one-fourth as much solids, or 7.15 per cent. Furthermore, these beans generally contained more added salt than the other varieties, so so that the actual bean solids present averaged only 6.28 per cent.

The relative nutritive value of the three classes of beans is shown by the fact that on the average the drained solids in red kidney beans yield 108, lima beans 91 and wax and string beans 20 calories per 100 gms.

It is interesting to note that the liquor accompanying the

red kidney and the lima beans contained more nutriment than the drained wax and string beans themselves, and it is obvious that the housekeeper who discards the liquor of the two first-named varieties of beans throws away considerable valuable nutriment. The liquor of wax and string beans, on the other hand, is scarcely worth saving as it contains only 2.5 per cent. of salt-free solids.

Content of Tin.

Tin was determined in the solids and the liquor of all the samples, except in twelve liquors which were discarded by mistake. Table V shows the amounts found, expressed as mgms, per kilo or parts per million.

Table V.—Tin in Canned Beans (Mgms. per Kilo or Parts per Million.)

Number.	Tin. In solids.	Tin. In liquor.	Number.	Tin. In solids.	Tin. In liquor.	Number.	Tin. In solids.	Tin. In liquor.	Number.	Tin. In solids.	Tin. In liquor.
Red Kidney.			*Lima.*			*Wax or String.*			*Wax or String.*		
7995	117	32	8082	116	51	8069	338	62	8101	340	76
8099	204	26	8075	163	41	8068	368	77	7993	246	*
8010	164	35	8001	197	58	8043	382	104	8085	169	44
8084	108	40	8096	148	88	8093	106	32	8045	252	43
8105	210	26	8009	254	73	8079	577	69	8014	362	*
Lima.			8094	105	45	8007	348	*	8032	313	*
8034	157	49	8086	93	32	8076	410	98	8102	256	46
8090	121	73	8100	112	37	7996	430	*	8000	253	*
8022	224	116	8103	127	56	8074	199	52	8023	217	*
8049	123	54	8031	149	38	7994	196	*	8089	353	98
7999	118	70	8077	101	58	8081	381	91	8083	219	59
8071	147	102	8011	150	53	8087	283	54	8106	463	91
8042	163	34	8047	122	34	7997	425	*	8016	391	*
8104	129	35	*Wax or String.*			8050	311	75	8070	316	75
8080	121	48	8033	471	*	8097	630	121	8012	155	*
8095	116	63	8091	240	44	8098	272	54	8046	186	42

* Not determined.

The following is a summary of Table V:

	Red Kidney. Max.	Min.	Ave.	*Lima.* Max.	Min.	Ave.	*Wax and String.* Max.	Min.	Ave.
In solids, mgms. .	210	108	161	254	93	142	630	106	319
In liquor, mgms. .	40	26	32	116	32	56	121	32	69

The above figures are in entire harmony with those reported by other investigators. Canned beans as a rule show relatively large amounts of tin, wax and string beans generally containing much more than either red kidney of lima beans. The degree of toxicity of tin is still a somewhat open question, but at any rate its presence in any considerable quantity in a food is objectionable. The source of this tin is of course, the tin container, the amount contained in the food depending in part on the age of the food and the storage temperature. In the case of beans, and similar slightly acid foods, the tin present in the canned product has been shown to be due in part in some cases to the amino bodies present. It has been erroneously assumed that the tin in canned foods was in solution. Bigelow* (*Research Laboratories, Nat. Canners' Asso., Bull. 2, Aug. 1914), however, has shown that the tin is largely, sometimes chiefly, in some insoluble form. Moreover we are not justified in assuming that all of the tin found in the liquor even is in a soluble form, for it is quite probable that much of this is present as a finely divided "insoluble oxid, hydrated oxid, or basic salt of tin." Furthermore it is possible that much of the tin seemingly in solution is in colloidal form.

The smallness of our samples prevented further investigation along these very interesting lines. Nevertheless the fact remains that a number of these samples contained excessive amounts of tin. If it is possible for one packer of red kidney beans to keep the tin in his product down to 108 mgms., there seems to be no justifiable reason why another's brand should contain 210 mgms. in the drained beans. Similarly with lima beans, one brand showed only 93 mgms., and ten others less than 125 mgms., while two brands contained 224 and 254 mgms. In spite of the fact that wax and string beans as a rule carry more tin than other beans, we find one brand with only 106 mgms. in the drained solids; on the other hand twelve brands contained from 300 to 400 mgms.; six brands from 400 to 600 mgms.; and one brand 630 mgms. If these large amounts of tin are due to storage conditions and the age of the sample, it would seem that the consumer should be provided with some protection against such a situation.

ACIDITY OF LIQUOR.

It has been suggested that the tin content is measured largely by the acidity of the liquor. Our results, however, indicate that

this is not the determining factor, as there is no close connection between the acidity of the bean liquor and the amount of tin present. The sample of red kidney beans showing the highest acidity contained the least tin, while the two brands of lima beans and the brand of string beans containing the most tin were all relatively low in acidity. The average acidity of the red kidney beans was 26.4, that of the lima beans 18.0, and that of the wax and string beans 9.6, while the last-named contained on the average twice as much tin in the solids as either the red kidney or lima beans.

EXPERIMENTS WITH BREAD.

These experiments have taken up the following points:

1. The advantages or disadvantages following the use of "yeast food" or "bread improvers," more particularly *Arkady Yeast Food.*
2. The losses of food nutriments in the baking of bread.
3. The determination of fat in bread.
4. A study of tolerances for the net weight of loaves of bread:
    a. Losses in weight due to drying out of the bread.
    b. Variations in weight of loaves due to bakery manufacturing conditions.

1. The Advantages or Disadvantages Following the Use of Yeast Foods or Bread Improvers.

The chief chemist of this Station has been charged by the Joint Committee on Food Definitions and Standards, with the collection of data relative to the preparation of a definition and the formulation of standards for bread. Incidental to this work it was deemed a matter of great importance to determine the role played in bread manufacture by the various "yeast foods" and "bread improvers," which are being brought more and more to the attention of bakers. These products are of two general classes: the malt preparations (extracts or flours), and the compounds which are alleged to supply to the yeast certain nutrients, which either stimulate the yeast or, by supplying particularly suitable food, increase its activity.

Five malt extracts, four malt flours and five samples of a yeast food were analyzed. These were as follows:

Malt Extracts.

9549. *Diamalt.*, The American Diamalt Co., Cincinnati, O.

9541. *Malt Extract*, Freihofer Baking Co., Philadelphia, Pa.

9546. *O. P. Malt*, Malt-Diastase Co., New York.

10004. *Roloco*, The Corby Co., Washington, D.C.

9453. *Malt Extract* (manufacturer unknown), used in test by S. S. Thompson Co., New Haven.

	9540	9541	9546	10004	9453
Alcohol by volume	3.20	3.20	5.20	*	*
Extract	75.41	75.72	74.42	76.92	76.92
Ash	1.47	1.63	1.85	0.87	1.83
Protein (N x 6.25)	5.63	7.63	6.75	3.44	6.44
Sugar solids + glycerin	68.31	66.46	65.82	72.61	68.65
Direct reducing sugars, as dextrose	41.70	41.02	40.04	*	*
Dextrin	21.05	22.04	20.78	*	*
Glycerin	0.12	0.12	0.12	*	*
Diastatic power (degrees (Lintner)	62.5°	105°	74°	*	*

* Not determined.

These samples are quite similar in composition, although No. **9541** shows a somewhat higher Lintner value than the other two brands tested.

Malt Flours.

9545. *Diasto Dry Malt*, Chas. E. Mechel, Milwaukee, Wis.

9543. *Maltora*, The Cabell Co., Baltimore, Md.

9544. *Malzo*, Advance Malt Products Co., Chicago, Ill.

9542. *Plymco*, Plymouth Milling Co., LeMars, Iowa.

	9545	9543	9544	9542
Water	6.02	7.91	9.94	11.15
Ash	2.21	2.34	1.63	0.36
Protein (N x 6.25)	15.38	14.81	14.06	8.94
Ether extract	2.51	2.62	2.12	0.55
Fiber	2.02	2.17	0.99	0.08
Nitrogen—free extract	71.86	70.15	71.26	78.92
Starch	44.38	46.01	48.60	72.17
Diastatic power	high	high	high	very low

The first three samples are very similar in composition. These three brands likewise all showed high diastatic power, No. **9544** being somewhat higher than the others. No. **9542** is a very

different preparation both as regards composition and diastatic activity, the latter being extremely low.

Yeast Food.

9424, 9514. *Arkady Yeast Food,* Ward Baking Co., New York.

	9424	9514
Water	5.99	5.58
Ash	49.45	48.47
Protein (N x 6.25)	4.75	4.38
Carbohydrates	36.34	38.08
Fat	0.38	0.38
Ammonia	3.09	3.11
Potassium bromate	0.298	*
Calcium oxid	9.64	*
Sulphuric anhydrid	13.31	*
Sodium chlorid	present	present

* Not determined.

Three other samples contained 5.41, 5.37 and 6.52 per cent. of moisture.

The formula of this preparation as given by the manufacturer is as follows:

Calcium sulphate	25.0
Ammonium chlorid	9.7
Potassium bromate	0.3*
Sodium chlorid	25.0
Patent wheat flour	40.0

Our two analyses satisfy this formula in all respects.

Baking Tests.

A series of baking tests were conducted to study the effect of *Arkady Yeast Food,* our experiments at this time being limited to this particular preparation for the following reasons: First, it has been specifically attacked both as to the purposes of its use and because of alleged objectionable mineral ingredients it introduces into the bread; second, because it represents a distinct type of these foods (*i.e.* it is largely a mineral food); third, because no question has been raised as to objectionable ingredients being introduced by malt extracts or malt flours; and fourth, because of the time and labor consumed it was necessary to limit our first experiments to a single preparation.

The method of conducting the tests was as follows: Batches of dough ranging from 78 to 709 lbs. were prepared under strict

supervision, generally either under that of the writer or some other official authority, in one series the baker's regular formula being used; in the other Arkady was introduced, the amount of sugar, salt, yeast and generally flour being reduced. The weighing of all the ingredients was supervised, as well as that of the dough during its various stages, and that of the finished bread. Samples of the various ingredients and the baked breads were taken for analysis, either in triplicate or quadruplicate. Every precaution was taken to avoid mechanical loss during the tests, the loaves being molded by hand and a record being kept of the weight of dusting flour used. A complete baking record was kept for each test.

Disinterested parties supervised the weighings and various operations in all the tests but four (the latter being conducted independently by the baker although the writer analyzed the materials and the breads). Similarly the materials and the breads were always analyzed by three, and sometimes by four, laboratories, in every case, except the tests referred to above, at least two official laboratories taking part in the analysis. The following tabulation shows the extent of official supervision in each test.

Test.	*Bakers.*	*Supervisors.*
1	Ward Bakery, New York	3 Government chemists and writer.
2	" " "	" " " " "
3	" " "	Writer.
4–7	" " "	No official supervision.
8	Thompson Bakery, New Haven,	Writer and his assistant.
9	" " "	Writer's assistant.
10	Washington Barracks, D.C.	U. S. Army officers.
11–12	Taggart's Bakery, Indianapolis	State chemist.

In each of the twelve tests samples of the baking materials and the breads were sent to the writer for analysis. Likewise all the analytical data obtained by the various analysts has been submitted to the writer, and while these will of course be presented to the Standards Committee, only the results of our own laboratory will be discussed here.

Table VI shows the composition of the various baking materials and Tables VII to IX that of the breads, as determined in this laboratory. The analyses of the ingredients require no comment, except to call attention to the fact that actual analyses were made in all cases, except the oil and lard used. These were assumed

to be entirely fat, and even were this assumption not strictly correct, no error is introduced as in every comparative Non-Arkady and Arkady test equal amounts of these shortening materials were used.

TABLE VI. ANALYSES OF BAKING MATERIALS.

Material.	Baking test.	Water.	Ash.	Protein.	Carbohydrates.	Fat.
Flour, No. 1	1 & 2	12.49	0.50	10.72[1]	75.00	1.29
" No. 2	1 & 2	13.29	0.38	10.66[1]	74.56	1.11
" No. 3	3	12.89	0.46	11.00[1]	74.36	1.29
" "	4	13.20	0.40	10.66[1]	74.45	1.29
" "	5	13.29	0.40	10.94[1]	74.08	1.29
" "	6	13.40	0.45	10.89[1]	74.04	1.22
" "	7	13.03	0.49	11.00[1]	74.21	1.27
" No. 4	8	12.91	0.42	10.83[1]	74.74	1.10
" "	9	12.64	0.44	10.94[1]	74.86	1.12
" No. 5	10	12.82	0.53	11.69[1]	73.40	1.56
" No. 6	11	13.12	0.39	10.09[1]	75.31	1.09
" "	12	13.15	0.37	10.37[1]	74.98	1.13
Skim milk, condensed	1 & 2	30.97	1.97	8.29[2]	54.70	4.07
" " "	3–7	35.23	2.03	8.60[2]	49.79	4.35
" " "	11	32.14	2.03	8.93[2]	53.20	3.70
" " "	12	29.79	2.14	9.12[2]	54.82	4.13
Skim milk	8 & 9	91.68	0.69	2.81[2]	4.40	0.42
Yeast, Corby's	1–7	73.81	2.42	14.88[3]	8.60	0.29
" "	10	72.50	2.54	15.62[3]	9.03	0.31
" "	11	70.93	2.41	14.75[3]	11.44	0.47
" "	12	75.70	2.41	14.56[3]	6.87	0.46
Arkady Yeast Food	1 & 2	5.99	49.45	4.75[4]	36.34	0.38
" " "	3–7	5.41	...	...	...	..
" " "	8 & 9	5.37	...	...	...	...
" " "	10	5.58	48.47	4.38[5]	38.08	0.38
" " "	11 & 12	6.52	...	...	...	0.41
Roloco, Corby's	11 & 12	23.08	0.87	3.44[3]	72.61	0.00
Malt extract	8	23.08	1.83	6.44[3]	68.52	0.13
Sugar	all	0.03	...	...	...	...
Salt	all	0.11	99.89	...	...	...
Cotton seed oil (assumed)	...	...	...	...	...	100.00
Lard (assumed)	8 & 9	...	...	...	...	100.00

[1] N x 5.7.
[2] N x 6.38.
[3] N x 6.25.
[4] N x 6.25 (plus 3.09% ammonia as chlorid.
[5] N x 6.25 (plus 3.11% ammonia as chlorid.)

TABLE VII.—ANALYSES OF BREADS (1 *hr. after baking*).

Bread.	Baking test.	Water.	Ash.	Protein (N×5.7).	Carbohydrates.	Fat.
Non-Arkady..........	1	37.11	1.36	7.58	51.77	2.18
"	2	36.35	1.45	7.81	52.34	2.05
"	3	36.18	1.41	7.28	52.85	2.28
"	4	36.51	1.36	7.58	52.25	2.30
"	5	36.23	1.46	7.57	52.61	2.13
"	6	37.67	1.47	7.49	51.20	2.17
"	7	35.38	1.43	7.88	53.32	1.99
"	8	31.84	1.74	8.61	55.98	1.83
"	9	34.59	1.52	8.01	53.90	1.98
"	10	38.32	1.53	7.86	51.36	0.93
"	11	39.48	1.24	6.90	50.63	1.75
"	12	36.09	1.26	7.42	53.42	1.81
Average (omitting tests 8 and 11)*.........		**36.44**	**1.43**	**7.65**	**52.50**	**1.98**
Arkady..............	1	36.60	1.49	7.87	52.03	2.01
"	2	35.27	1.53	7.92	53.13	2.15
"	3	35.95	1.45	7.69	52.57	2.34
"	4	35.33	1.40	7.84	53.08	2.35
"	5	35.59	1.47	7.85	52.89	2.20
"	6	37.16	1.47	7.64	51.47	2.26
"	7	36.06	1.49	7.75	52.66	2.04
"	8	34.61	1.73	8.19	53.70	1.77
"	9	35.74	1.54	7.88	53.04	1.80
"	10	37.85	1.55	8.10	51.47	1.03
"	11	37.72	1.13	7.08	52.27	1.80
"	12	34.91	1.24	7.53	54.49	1.83
Average (omitting tests 8 and 11)*.........		**36.05**	**1.46**	**7.81**	**52.68**	**2.00**

* See page 119 for reasons for ommission.

TABLE VIII.—LIME, SULPHATES AND AMMONIA IN BREADS. (*In Original Substance*).

Bread.		Sulphuric anhydrid.				Bread.		Sulphuric anhydrid.			
		Method. 1.*	Method. 2.**	Lime (CaO).	Ammonia. (NH_3).			Method 1.*	Method 2.**	Lime (CaO).	Ammonia. (NH_3).
		%	%	%	%			%	%	%	%
Non-Arkady	1	.089	.015	.022	.0008	Arkady	1	.097	.060	.051	.0019
"	2	.056	.016	.015	.0007	"	2	.074	.055	.042	.0053
"	3	.043	.011	.020	.0008	"	3	.058	.055	.049	.0053
"	4	.040	.015	.023	.0008	"	4	.075	.059	.041	.0041
"	5	.056	.014	.017	.0027	"	5	.106	.052	.055	.0036
"	6	.027	.009	.017	.0011	"	6	.070	.045	.050	.0052
"	7	.050	.019	.018	.0017	"	7	.067	.059	.039	.0062
"	8	.063	.024	.031	.0019	"	8	.075	.077	.050	.0071
"	9	.077	.020	.023	.0009	"	9	.102	.071	.047	.0037
"	10	.085	..	.009	.0017	"	10	.114	..	.044	.0087
"	11	.068	.015	.021	.0017	"	11	.083	.056	.041	.0062
"	12	.050	.020	.024	.0019	"	12	.093	.061	.036	.0069
Average		**.059**	**.016**	**.020**	**.0014**	**Average**		**.085**	**.059**	**.046**	**.0051**

* Bread ashed, then treated with HCl.
** Bread treated with HCl. direct without ashing.

TABLE IX.—BROMIN IN BREADS.

(Parts of Br. per 100,000 parts of air-dry bread.)

Non-Arkady.		Arkady.	
1	0.25	1	0.50
2	0.25	2	0.50
3	0.25	3	0.50
4	0.25	4	0.50
5	0.425	5	0.75
6	0.425	6	0.75
7	0.25	7	0.50
8	0.30	8	0.625
9	0.25	9	0.50
10	0.25	10	0.50
11	0.30	11	0.625
12	0.30	12	0.688
Average	**0.29**	**Average**	**0.58**

On the following pages will be found the formulas used, the baking record, and the dry matter found in the materials and the breads of each test. Test 8, made at the Thompson Bakery, New Haven, has been omitted throughout, as a mixing of the loaves of the baked bread after sampling, in this test gave absurd and impossible results. Similarly the results of test 11 are also omitted as during the shipment of the breads from Indianapolis, the package became broken and possibly some bread was lost.

TABLE X.—BAKING FORMULAS.

Material.	Tests 1–2.		Tests 3–7.		Test 9.		Test 10.		Tests 11–12.	
	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Flour	425*	419*	215*	212*	218*	218*	50*	49*	208*	208*
Water	240	240	120	120	93	94½	26	26	115	118
Sugar	11	9	5½	4½	5	4	7/8	3/4	...	...
Salt	7	6½	3½	3¼	4	3¾	7/8	3/4	2 81/100	2 58/100
Cotton seed oil	10	10	5	5	..	..	..	..	2 1/100	2 81/100
Lard	..	..	..	..	4	4	..	..	...	...
Condensed skimmed milk	11	11	5½	5½	..	..	..	..	10	10
Skimmed milk	..	..	..	..	32	32	..	..	...	...
Yeast	5	2½	2½	1¼	2	1	½	¼	3	1½
Arkady	..	2⅛	..	2 1/16	..	1	..	..	...	...
Roloco	..	..	..	..	..	..	...	..	8	7

* Dusting flour was added in each test as follows:

Non-Arkady: 1, 3.75 lbs., 2, 2.5 lbs., 3, 1.75 lbs., 4, 3.25 lbs., 5, 1.75 lbs., 6, 2.25 lbs., 7, 2.25 lbs., 9, 3 lbs., 10, 0.5 lb., 11, 2.25 lbs., 12, 2.81 lbs.

Arkady: 1, 5.5 lbs., 2, 4.25 lbs., 3, 2.75 lbs., 4, 2.25 lbs., 5, 2.5 lbs. 6, 2.5 lbs., 7. 2.75 lbs., 9, 3.5 lbs., 10, 0.5 lb., 11, 2.25 lbs., 12, 2.38 lbs.

Baking Formulas.

No attempt was made to dictate the baking formula used, this representing in all cases for the Non-Arkady bread the regular formula used at the bakery where the test was being conducted. Accordingly we have formulas representing the practice in a large wholesale bakery, in two smaller high-class bakeries and in a Government barracks bakery. In every case modifications of the regular formula were made necessary in the Arkady dough because of the use of that ingredient. The following decreased amounts were used in the Arkady doughs:

Tests 1-2. 6 lbs. flour, 2 lbs. sugar, 0.5 lb. salt, 2.5 lbs. yeast.
Tests 3-7. 3 lbs. flour, 1 lb. sugar, 0.25 lb. salt, 1.25 lb. yeast.
Test 9. 1 lb. sugar, 0.25 lb. salt, 1 lb. yeast.
Test 10. 1 lb. flour, 0.125 lb. sugar, 0.125 lb. salt, 0.25 lb. yeast.
Tests 11-12. 1 lb. Roloco, 0.25 lb. salt, 1.5 lbs. yeast.

Loss of Dry Matter in Baking Bread.

Table XI shows the amounts of dry matter introduced into the doughs by the ingredients used and the actual amounts recovered in the baked breads.

The results in Table XI may be summarized as follows:

Losses of Dry Matter.

	Pounds.		Per cent.		Less percentage loss shown by Arkady breads
	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.	
1	21.006	13.155	5.12	3.25	1.87
2	15.474	5.253	3.79	1.30	2.49
3	6.947	4.233	3.36	2.07	1.29
4	6.231	3.456	3.00	1.70	1.30
5	4.962	2.353	2.41	1.16	1.25
6	5.181	3.881	2.51	1.91	0.60
7	5.702	1.080	2.75	0.53	2.22
9	6.994	2.698	3.34	1.29	2.05
10	1.340	0.675	2.93	1.51	1.42
12	6.089	2.998	3.01	1.49	1.52
Average	.....	.....	**3.22**	**1.62**	**1.60**

In every test the Non-Arkady breads showed the greater loss in dry matter. This ranged from 1.340 to 21.006 lbs.; the Arkady breads showed losses of from 0.675 to 13.155 lbs.; in both cases the losses varying to a considerable extent with the amount of flour used. The percentage loss of dry matter in the Non-Arkady

Baking Record.

	Test 3.		Test 4.		Test 5.		Test 6.		Test 7.	
	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.
Temperature of flour	80.0	80.0	82.4	82.4	83.5	83.5	84.1	84.1	82.7	82.7
" " water	50.0	50.0	49.0	49.0	49.0	49.0	46.0	46.0	49.0	49.0
" " room	80.0	80.0	88.0	88.0	84.1	84.1	86.4	96.4	80.2	80.2
Started mixing	8.10	8.48	7.50	8.30	7.57	8.30	8.04	8.44	7.44	8.25
Finished mixing	8.25	9.02	8.01	8.45	8.07	8.42	8.17	8.56	7.57	8.36
Temperature of dough when mixed	81.2	81.0	81.0	81.6	80.9	80.8	81.0	81.9	80.9	80.4
Weight of dough when mixed, lbs.	355.5	352.0	354.75	350.5	354.0	350.25	354.5	349.75	355.5	351.75
First turn	10.55	11.32	10.31	11.15	10.37	11.12	10.47	11.26	10.27	11.06
Temperature at first turn	82.5	81.6	82.3	82.6	81.4	81.8	81.9	82.6	81.7	81.1
Second turn	12.25	1.02	11.46	12.30	11.52	12.27	12.02	12.41	11.42	12.21
Temperature at second turn	83.3	82.1	82.6	82.7	82.1	82.4	83.2	82.6	81.8	80.7
Dough ready for scaling	12.55	1.32	12.31	1.15	12.37	1.12	12.47	1.26	12.27	1.06
Weight of dough when scaled, lbs.	352.5	350.25	353.25	348.24	351.25	349.0	..	..	353.25	350.0
Dough in proof box	1.35	2.10	1.15	2.00	1.27	2.05	1.15	1.57	1.03	1.48
Number of loaves	211	205	212	208	204	206	210	208	207	207
Dough going to oven	2.32	3.04	2.18	3.15	2.34	3.10	2.32	3.04	2.12	3.09
Bread baked	3.14	3.48	2.43	3.50	3.03	3.40	2.54	3.29	3.05	3.41
Weight of bread 1 hr. old	313.5	313.0	317.25	309.5	315.5	312.5	322.75	317.5	311.75	318.0

BAKING RECORD.

	Test 1.		Test 2.		Test 9.		Test 10.		Test 11.		Test 12.	
	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.
Temperature of flour	61.7	61.7	66.5	66.5	76.8	76.8	74.0	74.0	73.7	73.7	75.0	75.0
" " water	51.0	51.0	52.0	52.0	78.0	77.0	86.0	86.0	50.0	50.0	60.0	60.0
" " room	79.0	81.0	80.0	80.0	80.0	80.0	80.0	80.0	78.0	78.0	76.0	76.0
Started mixing	10.55	12.24	9.36	10.35	7.39	8.10	8.07	8.10	7.49	8.48	6.46	7.37
Finished mixing	11.08	12.38	9.50	10.50	7.47	8.18	8.30	8.33	8.20	9.08	7.07	8.03
Temperature of dough when mixed	81.9	81.6	81.0	81.0	81.0	81.0	84.0	84.0	77.1	78.0	80.5	80.2
Weight of dough when mixed	704.19	695.94	704.24	699.25	357.5	358.0	78.75	77.5	340.5	344.25	343.75	344.75
First turn	1.35	2.54	12.20	1.20	10.32	11.03	10.59	11.01	11.00	11.38	9.42	10.35
Temperature at first turn	83.2	82.9	82.0	82.0	82.4	82.2	87.0	86.5	77.9	79.0	81.3	80.8
Second turn	2.35	3.54	1.20	2.20	11.32	12.03	11.59	12.01	12.30	1.08	10.42	11.35
Temperature at second turn	84.1	83.6	82.5	83.0	83.1	82.2	..	..	80.3	80.3	81.2	81.3
Third turn	3.20	4.39	2.05	3.05	..	..	..	..	..	..	..	..
Temperature at third turn	85.2	82.6	83.0	82.5	..	..	..	..	..	..	..	..
Dough ready for scaling	3.40	5.00	2.30	3.25	12.40	1.11	1.04	1.12	1.15	1.45	11.27	12.15
Weight of dough when scaled	698.	691.5	696.75	692.50	354.25	355.5	78.0	77.0	339.	343.	341.25	343.25
Dough in proof box	4.36	5.48	3.23	4.15	1.02	1.45	1.10	1.13	1.39	2.05	12.05	12.35
Number of loaves	410	413	410	415	312	315	35	35	..	..	..	..
Dough going to oven	5.30	6.45	4.21	5.15	2.05	3.05	2.25	2.33	2.28	3.05	12.54	1.36
Bread baked	6.00	7.15	4.52	5.46	2.25	3.35	3.55	4.03	3.02	3.45	1.29	2.10
Weight of bread 1 hr. old	618.75	618.50	616.75	614.75	309.25	321.25	72	71	303	306.75	307.5	305.5

Baking Record.

The baking record is given herewith in full, but the details 'll not be discussed here.

TABLE XI.—DRY MATTER IN MATERIALS AND BREAD.

	Test 1.		Test 2.		Test 3.		Test 4.		Test 5.	
	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.
Flour	370.218	364.990	370.218	364.990	187.287	184.673	186.620	184.016	186.427	183.825
Sugar	10.997	8.997	10.997	8.997	5.499	4.499	5.499	4.499	5.499	4.499
Salt	6.992	6.493	6.992	6.493	3.496	3.247	3.496	3.247	3.496	3.247
Cotton seed oil	10.000	10.000	10.000	10.000	5.000	5.000	5.000	5.000	5.000	5.000
Condensed skim milk	7.593	7.593	7.593	7.593	3.562	3.562	3.562	3.562	3.562	3.562
Yeast	1.310	0.655	1.310	0.655	0.655	0.328	0.655	0.328	0.655	0.328
Arkady	....	1.998	....	1.998	...	1.005	...	1.005	...	1.005
Dusting flour	3.280	4.810	2.187	3.717	1.524	2.396	2.821	1.953	1.517	2.168
Total	410.138*	405.284*	408.035**	403.181**	207.023	204.710	207.653	203.610	206.156	203.634
Bread	389.132	392.129	392.561	397.928	200.076	200.477	201.422	200.154	201.194	201.281
Loss	21.006	13.155	15.474	5.253	6.947	4.233	6.231	3.456	4.962	2.353
Per cent. loss	5.12	3.25	3.79	1.30	3.36	2.07	3.00	1.70	2.41	1.16

* 0.252 lb. deducted for dough removed for fermentation test.

** 1.262 lb. deducted for dough removed for fermentation test.

TABLE XI.—DRY MATTER IN MATERIALS AND IN BREAD.—*Concluded.*

	Test 6.		Test 7.		Test 9.		Test 10.		Test 12.	
	Non-Arkady.	Arkady.	Non-Arkady.*	Arkady.	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.	Non-Arkady.	Arkady.
Flour	186.190	183.592	186.986	184.376	190.445	190.445	43.590	42.718	180.648	180.648
Sugar	5.499	4.499	5.499	4.499	5.000	4.000	0.875	0.750	6.154†	5.384†
Salt	3.496	3.247	3.497	3.247	3.996	3.746	0.875	0.750	2.810	2.560
Cotton Seed Oil	5.000	5.000	5.000	5.000	4.000‡	4.000‡	..	..	2.810	2.810
Condensed Skim Milk	3.562	3.562	3.562	3.462	2.662	2.662	..	..	7.021	7.021
Yeast	0.655	0.328	0.655	0.328	0.550	0.275	0.138	0.069	0.729	0.365
Arkady	...	1.005	...	1.005	....	0.946	..	0.236	....	0.993
Dusting Flour	1.949	2.165	1.957	2.392	2.621	3.058	0.273	0.273	2.440	2.067
Total	206.351	203.398	207.155	204.409	209.274	209.132	45.751	44.796	202.612	201.848
Bread	201.170	199.517	201.453	203.329	202.280	206.435	44.411	44.121	196.523	198.850
Loss	5.181	3.881	5.702	1.080	6.994	2.698	1.340	0.675	6.089	2.998
Per cent loss	2.51	1.91	2.75	0.53	3.34	1.29	2.93	1.51	3.01	1.49

‡ Lard.
† Roloco.

breads ranged from 2.41 to 5.12 and in the Arkady breads from 0.53 to 3.25. Although there are considerable variations in the decreased losses of dry matter where Arkady was used, it is a striking fact that in every test the Arkady bread showed a lower loss, ranging from 0.60 to 2.49, average, 1.60 per cent.

In the first two tests the loaves of bread after baking were weighed on a Fairbanks scale. Although the accuracy of this scale and its weights were tested at the time of our test, it was realized later that an error might have been introduced, the scale not being sensitive to less than one-quarter of a pound. Any such error in weighing would probably be compensative and would have no serious effect on the results where losses as high as from 5 to 20 lbs. were shown. In the subsequent tests all the baked breads were weighed on a torsion balance sensitive to one gram. The uniformity of the results of all the tests indicates that the scale used in no way vitiated the conclusions from the first two tests.

The effect of the use of Arkady in conserving the dry matter of the dough is shown in the following summary where it is seen that not only does Arkady uniformly decrease the losses in dry matter attendant upon fermentation, but that an actual saving of original ingredients is also secured without in any way decreasing the food value of the bread (as will be shown on a later page).

SAVING IN DOUGH INGREDIENTS.

Test.	Arkady used.	Flour.	Sugar.	Salt.	Yeast.	Roloco.	Total.	Net saving in ingredients.	Saving in dry matter of dough.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	2.125	4.25	2.00	0.50	2.50	....	9.25	7.125	7.85
2	2.125	4.25	2.00	0.50	2.50	....	9.25	7.125	10.22
3	1.063	2.00	1.00	0.25	1.25	....	4.50	3.437	2.71
4	1.063	4.00	1.00	0.25	1.25	....	6.50	5.437	2.78
5	1.063	2.25	1.00	0.25	1.25	....	4.75	3.687	2.61
6	1.063	2.75	1.00	0.25	1.25	....	5.25	4.187	1.30
7	1.063	2.50	1.00	0.25	1.25	....	5.00	3.937	4.62
9	1.000	0.50	1.00	0.25	1.00	....	1.75	0.750	4.30
10	0.250	1.00	0.125	0.125	0.25	....	1.50	1.25	0.67
12	1.063	0.43	....	0.25	1.50	1.00	3.18	2.117	3.09
Totals	11.878	22.93	10.125	2.875	14.00	1.00	50.93	39.052	40.15

In other words in making 2,414 loaves of bread weighing 3,505 lbs.; the use of 11.878 lbs. of Arkady allowed the saving of 22.93 lbs. of flour, 10.125 lbs. of sugar, 2.875 lbs. of salt, 14.00 lbs. of yeast and 1.00 lb. of Roloco malt extract, or a total net saving in raw materials of 39.052 lbs. At the same time 40.15 lbs. of the dry matter of the dough was saved from unnecessary destruction by the yeast ferments. Calculating these results to the basis of 1,000 1.5 lb. loaves of bread, the saving in ingredients following the use of Arkady were as follows:

Saved.	*Used in Addition.*
9.50 lbs. flour	4.92 lbs. Arkady =
4.19 " sugar	1.23 " calcium sulphate
1.19 " salt	0.48 " ammonium chlorid
5.80 " yeast	0.01 " potassium bromate
0.41 " Roloco	1.23 " sodium chlorid (salt)
	1.97 " flour

In addition to the above, 16.63 lbs. of the dry matter of the dough was saved per thousand 1.5 lb. loaves. When one considers the millions of loaves of bread made annually such a conservation as is shown by these tests is well worthy of careful attention. Other questions, however, arise in this connection, viz.: is this conservation effected at a sacrifice of quality in the bread, and does the use of Arkady introduce into the bread any objectionable ingredients? These questions will now be discussed.

Composition of the Breads.

The criticism has been made that the use of Arkady enables the baker to use a lower grade of flour, and that in reality the main role played by its mineral salts, particularly the potassium bromate, is that of bleaching agents. The results of certain baking experiments submitted to us throw light on this point, and indicate quite clearly that the potassium bromate improves the baking qualities of flours in general. Three flours were tested, a high patent hard spring wheat flour, a low grade clear hard spring wheat flour, and a high patent soft winter wheat. The experiments showed that, while the bromate was effective for all the flours, the higher the grade of the flour used the greater was its effect. A loaf of finer texture and color followed the use of bromate, but such a result obviously is one of the main purposes of leavening bread. Ammonium chlorid gave similar results;

that is, the effect of that salt was less when low grade flours (containing a relatively high ash) were used than when the flour was a *high patent*, indicating that the ash ingredients of the lower grade flours provided sufficient mineral food for the yeast, and that the use of Arkady with a flour of this class was not advantageous.

The experiments quoted above also showed that the fineness of texture and the color of the crumb depended to a considerable extent on the amount of yeast used. While the bread made with Arcady was better in texture, color and general appearance than one made with the same amount of yeast but without Arkady, it was not of as good appearance or of as great volume as one where double the amount of yeast was used without Arkady. In other words the yeast itself appeared to have what might be considered a decided bleaching effect.

The quality of the breads obtained from the different doughs is clearly shown in Table VII. It has been claimed that Arkady increases the water-holding power of the dough and that a more moist bread results, in other words that its use permits the baker to market excess water as bread. Our tests show the contrary to be the case. Omitting test 8 for reasons already given, in only two of the ten tests did the Arkady bread contain more moisture than the other. The average moisture content of the Non-Arkady breads was slightly higher, 0.39 per cent., than in those where Arkady was used. Not only did the Arkady breads contain less water, but they also contained slightly more of each of the food nutrients. Moreover, unpublished experiments of Winslow and Falk of the Yale Medical School show that this slightly increased food value was not secured at the sacrifice of digestibility. Quoting these authorities: "If the results of this experiment, taken as a whole, indicate any effect of Arkady salts upon the digestibility of bread, the effect is a favorable rather than an inhibitory one. * * * We may safely conclude that the digestibility of Arkady bread is not effected by the yeast food used in its manufacture."

It is apparent, therefore, that the use of Arkady does not increase the moisture content of the bread, that it slightly increases its food value, and that it in no way decreases the bread's digestibility.

The Role of the Mineral Salts in Arkady.

There are, however, two other important points to be considered, namely, what is the fate of the mineral salts in the bread, and what effect, if any, do they have on its wholesomeness.

The Arkady process was developed from observations that breads made at different bakeries by the same process and using the same formulas and baking ingredients showed marked variations in flavor, texture and quality. Extensive investigations pointed to the different waters used as the source of the difference and that the varying amounts of inorganic salts contained in the different waters were the determining factor. The effect of the composition of the waters used has long been known in the brewing industry, the superiority of the waters of the Trent having given Burton ales a recognized high place among such products. Likewise it is an established fact that yeast needs certain mineral salts for its proper development and growth. While carbohydrates and nitrogenous matters are of course needed for the yeast's growth, the mineral salts are perhaps even more necessary. Experiments by Kohman and Hoffman* (**Jour. Ind. Eng. Chem.* 1916, 8, 781–789; *do.* 1917 9, 148–159), who developed the Arkady process, have shown that small amounts of calcium sulphate, ammonium chlorid and a trace of potassium bromate gave the most satisfactory results, and that a combination of these salts in the proper proportions worked better than any one of the salts by itself. The experiments of these authorities seem to establish that the calcium sulphate stimulates fermentation and increases the gas production, that the ammonium chlorid is used directly as a food by the yeast and that practically none is found as such in the baked bread, and that the potassium bromate has a marked effect in maturing the gluten, thereby conserving flour and sugar and effecting a considerable saving in the amount of yeast required. Experiments of Winslow and Falk show that the potassium bromate, in the dilutions in which this salt is introduced into bread by the Arkady process, has a pronounced effect in accelerating proteolytic ferments, an action similar to that observed in the dough.

Calcium Sulphate.

Lime and sulphates were determined in all the samples of bread. As was to be expected, in every instance, the Arkady breads con-

tained slightly more of these two mineral ingredients. The Non-Arkady bread contained on the average 0.020 and the Arkady 0.046 per cent. lime (CaO), with 0.059 and 0.085 per cent. of sulphate (as SO_3), respectively. (Direct treatment of the bread without ashing gave much lower percentages of sulphate in all the breads.) In other words, the Non-Arkady breads contained on the average 0.079 and the Arkady 0.135 per cent. of calcium sulphate. The amount of lime even in the Arkady breads is still only about one-tenth of the amount recognized as necessary in our daily diet. Many of our common foods are deficient in lime, and while the slightly increased content of lime in the Arkady breads probably has little practical significance, its effect, if any, would be beneficial rather than injurious. Forbes has told us (address Washington Academy of Sciences, July, 1916) of calcium that "Physiologically it is the great mineral stabilizer. Practically, it is much more frequently lacking in the food of men and animals than in any other mineral nutrient." The claim that Arkady is used in bread for the purpose of a make-weight is obviously false and absurd.

Ammonium Chlorid.

The claim is made by the manufacturer that the ammonium chlorid introduced by Arkady is completely utilized by the yeast and that, therefore, no increased amount should appear in the bread. Our determination of this salt by distillation with magnesia as shown in Table VIII, indicate that while most of the added ammonium chlorid does not appear as such in the finished bread, still the Arkady breads contain slightly more than where Arkady was not used, the average percentage being 0.0051 as compared with 0.0014. This small increase, however, is entirely without significance and can have no possible deleterious effect on the wholesomeness of the bread. In fact, many of our well-known foods contain ammonia in far greater amounts than does Arkady bread, for instance, Allenburys' Milk Food 0.0105, Honor Dry Milk 0.0178, Mammala 0.0182, Horlick's Malted Milk 0.0185, Nestle's Food 0.0061, Eskay's Food 0.0076, Imperial Granum 0.0071, Camembert cheese 0.1239, canned lobster 0.0874, ham 0.0365, buttermilk 0.0337, Swiss cheese 0.0090 and American cheese 0.0056 per cent. (Hoffman and Kohman's results).

Potassium Bromate.

The claim is made that the potassium bromate of Arkady is broken up by the fermentative processes of the yeast, and in the baking process and that whatever bromin is left in the bread is in the form of potassium bromid. Our experiments, not entirely completed, seem to sustain this claim. The amounts of bromin found in the breads were extremely small, the average content of the Non-Arkady bread being 0.29 and of the Arkady bread 0.58 part of bromin per 100,000 parts of air-dry bread. Calculated to the basis of the original breads, these values would be about 0.10 and 0.20 part per 100,000, respectively. Such extremely small amounts of bromin as bromid would be without physiological effect. Moreover the fact has been recently brought out that bromin is much more widely distributed in nature than has usually been supposed, and that many of our common foods contain it in appreciable amounts.

We have determined bromin in a number of foods, by the same method as was used for the breads, with the following results:

Parts of Bromin per 100,000 *parts of Air-dry Substance.*

Table salt	6.27	Post Tavern Special	0.35
Fresh codfish	3.00	Gluten Bread	0.30
Salted codfish	1.50	Borden's Malted Milk	0.25
Celery	0.75	Brown Rice	0.25
Parsnips	0.75	Corn Meal	0.25
Haddock	0.50	Canned Lima Beans	0.25
Cabbage	0.50	Canned Kidney Beans	0.25
White Potatoes	0.40	Beets	0.25
Gluten Biscuit	0.35		

All of the above results as well as those secured in the breads, are doubtless slightly low owing to the difficulties of the method, but the results are at least comparative.

2. The Losses of Food Nutrients in the Baking of Bread.

In bread-making the action of the yeast causes a loss of carbohydrates, due to their fermentation and the formation of alcohol and carbonic acid gas, which are largely lost in the fermentation troughs or the oven.

The claim has been made that the use of Arkady not only requires less yeast but also that because of this smaller amount of and because of the nutrient salts contained in Arkady less

TABLE XII: LOSSES OF FOOD NUTRIENTS.

Test.	Kind of Dough.	Total Weight of Bread.	Losses of Water.	Ash.	Protein (N x 5.7).	Carbohydrates.	Fat.
1	Non-Arkady..	618.75	72.40	0.79	0.55	17.71	2.11
1	Arkady......	618.50	72.87	0.47	+1.95	12.17	3.12
2	Non-Arkady..	616.75	75.62	0.24	+0.97	14.75	2.91
2	Arkady......	614.75	78.81	0.25	+2.22	8.30	2.29
3	Non-Arkady..	313.50	38.09	0.24	1.85	4.19	0.88
3	Arkady......	313.00	37.87	0.36	0.24	3.16	0.68
4	Non-Arkady..	317.25	36.56	0.22	0.04	5.42	0.75
4	Arkady......	309.50	41.65	0.44	+0.73	3.24	0.73
5	Non-Arkady..	315.50	38.08	+0.07	0.65	3.28	1.31
5	Arkady......	312.50	40.00	0.18	+0.38	1.64	1.13
6	Non-Arkady..	322.75	31.14	+0.10	0.34	4.49	0.89
6	Arkady......	317.50	33.44	0.21	+0.24	3.23	0.67
7	Non-Arkady..	311.75	41.59	0.27	0.16	3.70	1.79
7	Arkady......	318.00	36.03	0.23	+0.33	+0.08	1.48
9	Non-Arkady..	309.25	44.75	0.54	0.62	5.35	0.49
9	Arkady......	321.25	37.80	0.51	0.02	1.33	0.84
10	Non-Arkady..	72.00	5.22	0.05	0.30	0.87	0.12
10	Arkady......	71.00	5.64	0.04	0.06	0.53	0.04
11	Non-Arkady..	303.00	30.11	0.21	1.92	16.40	0.18
11	Arkady......	306.75	35.80	0.73	0.90	9.18	+0.04
12	Non-Arkady..	307.50	38.84	0.07	0.67	5.30	0.05
12	Arkady......	305.50	44.82	0.38	0.24	2.36	0.02

of the carbohydrates of the flour and the added sugar are destroyed during the fermentation process. The very complete analyses we have made of these breads prepared under carefully controlled conditions affords an opportunity to test the accuracy of these claims.

We determined water, ash, protein, fat and (by difference) carbohydrates in all the ingredients used in the doughs and in the breads themselves. Knowing the formulas used we can determine the exact amounts of each of these ingredients introduced into the dough and the amounts recovered in the bread.

Table XII gives the net losses for each type of bread sustained by the doughs during the fermentation and baking periods. While some of the losses are so small that they might be accounted for by experimental error, certain facts stand out very clearly. The study of the losses of dry matter reported on an earlier page

TABLE XIII: SUMMARY OF LOSSES OF FOOD NUTRIENTS.

Test.	Kind of Dough.	Average total weight of bread.	Losses in total bake.					Losses per 100 pounds of Bread.				
			Water.	Ash.	Protein (N x 5.7).	Carbohydrates.	Fat.	Water.	Ash.	Protein (N x 5.7).	Carbohydrates.	Fat.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1–2	Non-Arkady	617.75	74.01	0.52	+0.21	16.23	2.51	11.98	0.08	+0.03	2.63	0.41
1–2	Arkady....	616.63	75.84	0.36	+2.09	10.24	2.71	12.14	0.06	+0.34	1.66	0.44
3–9, 11, 12	Non-Arkady	312.94	37.40	0.17	0.78	6.02	0.79	11.96	0.05	0.25	1.92	0.25
3–9, 11, 12	Arkady....	313.00	38.43	0.38	+0.04	3.01	0.69	12.28	0.12	+0.01	0.96	0.22
10	Non-Arkady	72.00	5.22	0.05	0.30	0.87	0.12	7.25	0.07	0.42	1.21	0.17
10	Arkady....	71.00	5.64	0.04	0.06	0.53	0.04	7.94	0.06	0.08	0.75	0.06
Ave.	Non-Arkady	......	.....	....	......	......	....	10.40	0.07	0.21	1.92	0.28
Ave.	Arkady....	......	.....	....	......	......	....	10.79	0.08	+0.09	1.12	0.24

showed that the losses in the Arkady breads were uniformly less than in the Non-Arkady breads. That these losses, regardless of whether or not Arkady was used, fell chiefly on the carbohydrates Table XII shows very clearly. There were slight losses of ash and fat, but the main loss was in carbohydrates. In seven of the twenty-two tests, however, there was an actual gain in protein and in only two tests was there a decided loss. That all but one of these protein gains were shown by Arkady breads and that the two decided pretein losses were shown by Non-Arkady breads is at least suggestive. Although in each Non-Arkady dough there was twice as much yeast used as in the corresponding Arkady dough, it would appear that the smaller amount of yeast in the presence of the Arkady mineral salts was actually able to construct protein from the ammonia of the ammonium chlorid in an amount more than sufficient to compensate for any losses sustained by the protein of the flour during the manufacturing process.

Table XIII shows the losses on a more comparable basis. Our doughs, based on weight of ingredients, fall into three well-defined classes, yielding either 600, 300 or 72 lbs. of bread. Calculated to the basis of losses per 100 lbs. of bread we find both kinds of dough lost about the same amounts of ash and fat, and that the Arkady dough lost 0.39 lb. more water, with 0.30 lb. less loss of protein and 0.80 lb. less loss of carbohydrates. It would appear, therefore, that in these tests the use of Arkady requires not only

half the normal amount of yeast, but that by using this smaller amount of yeast less carbohydrates were destroyed, and that the presence of the Arkady salts, more particularly ammonium chlorid, stimulated yeast production with an actual increase of protein in appreciable amounts. Moreover, as has been shown on a earlier page, this saving of food ingredients was secured without any sacrifice in the quality or nutritive value of the bread.

3. The Determination of Fat in Bread.

It has been frequently suggested that the official method used for determining fat in cattle feeds by means of ether extraction does not remove all the fat from bread or other baked products. The following method has been suggested by the Bureau of Chemistry to obviate this difficulty:

Method: Treat 5 gms. of material in a loosely stoppered 200 cc Erlenmeyer flask with a mixture of 10 cc alcohol (95%), 2 cc concentrated ammonia and 3 cc of water, heating 2 minutes at the boiling point. Cool, add three successive portions of 25 cc of ethyl ether, mixing thoroughly, and tamping the material each time with a glass rod flattened at the end, pouring off the extracts into a 200 cc beaker. The combined ether extracts are evaporated to dryness on the steam bath. The crude fat is extracted by washing out with several portions of anhydrous ether or preferably petroleum ether, collected in a tared flask, evaporating and drying for periods of 30 minutes at 100° C. until constant weight is obtained.

Table XIV: Percentage Amount of Fat in Bread.

Official method.	Modified method.	Official method.	Modified method.		Official method.	Modified method.
0.51	2.01	0.56	2.30		0.73	1.75
0.70	2.18	0.68	2.35		0.64	1.80
0.68	2.15	0.62	2.13		0.70	1.81
0.63	2.05	0.61	2.20		0.70	1.83
0.65	2.28	0.17	0.93	**Ave.**	**0.59**	**1.95**
0.69	2.34	0.21	1.03			

In sixteen of the samples of bread we determined fat both by the official method and the one outlined above. The results show conclusively the inapplicability of the official method to such products as bread, and indicate that practically all of the published analyses of bread are inaccurate as regards the amount of fat present. The average result secured by the official method was 0.59 per cent. and that by the Bureau method 1.95 per cent.

SAMPLES IN CLOSET.

	A			B			C			D		
	First.	Last.	Loss.	First.	Last.	Loss.	First.	Last.	Loss.	First.	Last.	Loss
	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.
	19.19	19.05	0.14	15.52	15.49	0.03	26.17	25.71	0.46	16.90	16.75	0.
	19.29	19.22	0.07	16.08	16.01	0.07	25.22	25.08	0.14	16.90	16.86	0.
	19.01	18.94	0.07	15.65	15.52	0.11	24.34	24.00	0.34	16.23	16.12	0.
	19.19	18.98	0.21	16.05	15.87	0.18	24.06	23.70	0.36	16.12	16.05	0.
	19.26	19.22	0.04	17.11	17.04	0.07	25.26	25.01	0.25	16.16	16.19	+0.
	19.61	19.44	0.17	16.72	16.51	0.21	24.73	24.41	0.32	16.61	16.51	0.
	19.51	19.40	0.11	16.51	16.40	0.11	25.33	25.01	0.32	17.14	17.00	0.
	18.84	18.77	0.07	15.77	15.63	0.14	24.13	24.00	0.13	16.58	16.51	0.
	19.33	19.26	0.07	15.77	15.52	0.25	24.62	24.30	0.32	16.97	16.86	0.
ve.	**19.25**	**19.14**	**0.11**	**16.13**	**16.00**	**0.13**	**24.87**	**24.58**	**0.29**	**16.62**	**16.54**	**0.**

SAMPLES ON SHELF.

	20.21	20.04	0.17	16.01	15.77	0.24	24.76	24.44	0.32	16.61	16.44	0.
	19.33	19.19	0.14	16.54	16.33	0.21	24.51	24.23	0.28	17.28	17.07	0.
	18.94	18.77	0.17	16.26	16.12	0.14	24.41	24.09	0.32	17.00	16.86	0.
ve.	**19.49**	**19.33**	**0.16**	**16.27**	**16.07**	**0.20**	**24.56**	**24.25**	**0.31**	**16.96**	**16.79**	**0.**
ve. of all	**19.31**			**16.17**			**24.79**			**16.71**		

4. EXPERIMENTS ON WEIGHTS AND LOSSES IN WEIGHT OF BREAD.

The bakeries of S. S. Thompson and the L. L. Gilbert Baking Corporation were visited on May 28 and samples of bread taken. In all cases the bread was wrapped and was slightly warm; with the Thompson samples the time since baking was 1½ hrs. with the Gilbert samples ¾ hr. The bread was weighed at the bakery, then taken to the laboratory, nine loaves of each series were piled three by three in a glass-front closet, each pile being kept separate from the others. The other three loaves of each sample were placed on an open shelf in the laboratory, each loaf being separated from its fellows. The bread was reweighed at 9 A M. on May 29, May 30, May 31 and June 1, or at intervals of 16, 40, 64 and 88 hrs. Inasmuch as the losses in weight were very trivial, the following tabulations give only the initial weight at the bakery and the final weight.

The breads were as follows:

A. S. S. Thompson Co. Health Bread. Claimed 18 oz., price 10 cts.

B. S. S. Thompson Co. Better-Yet Bread. Claimed 9 oz. or more, price 10 cts.

C. L. L. Gilbert Baking Corp. Holsum Bread. No weight claimed, price 15 cts.

D. L L. Gilbert Baking Corp. Butter-Krust. Claimed 14 oz., price 10 cts.

The experiment has three aspects:

1. Losses in weight before consumption.
2. Variations in weight of the loaves.
3. Ability of baker to meet reasonably any claimed weight.

1. *Losses in Weight before Consumption.*

The losses in weight after 88 hours were as follows:

In Closet.

A. 0.04 to 0.21, ave. 0.11 oz.
B. 0.03 to 0.25, ave. 0.13 "
C. 0.13 to 0.46, ave. 0.29 "
D. +0.03 to 0.15, ave. 0.08 "

On Shelf.

A. 0.14 to 0.17, ave. 0.16 oz.
B. 0.14 to 0.24, ave. 0.20 "
C. 0.28 to 0.32, ave. 0.31 "
D. 0.14 to 0.21, ave. 0.17 "

Even after a period of nearly four days the losses in weight were in general trivial, the larger loaves, C, showing somewhat larger losses. Likewise the samples kept on the open shelves lost somewhat more than those kept in the closet. There were practically no losses in the wrapped loaves up to 40 hours. The first two days of the experiment were rainy or cloudy, the last two bright and clear.

The temperature in the room in which the loaves were kept showed the following variations from day to day:

55 to 62°, 56 to 61°, 59.5 to 66°, and 64 to 70° Fahr.

2. *Variations in Weight of the Loaves.*

A. From 18.84 to 20.21, average 19.31 oz.
7 varied less than 0.25 oz. from average
11 varied less than 0.50 oz. from average
1 varied more than 0.50 oz. from average

B. From 15.52 to 17.11, average 16.17 oz.
- 4 varied less than 0.25 oz. from average
- 9 varied less than 0.50 oz. from average
- 3 varied more than 0.50 oz. from average

C. From 24.06 to 26.17, average 24.79 oz.
- 3 varied less than 0.25 oz. from average
- 8 varied less than 0.50 oz. from average
- 4 varied more than 0.50 oz. from average

D. From 16.12 to 17.28, average 16.71 oz.
- 6 varied less than 0.25 oz. from average
- 9 varied less than 0.50 oz. from average
- 3 varied more than 0.50 oz. from average

Summary.
- 20 varied less than 0.25 oz. from average
- 37 varied less than 0.50 oz. from average
- 11 varied more than 0.50 oz. from average

Judging simply from the variations in weight above or below the average the above figures show that the bakers have difficulty in scaling their loaves to a uniform weight. This fact, however, does not prevent them from making a claim for weight which they can live up to if a little more tolerance is permitted for over-weight than under-weight, as the following consideration will show:

3. *Ability of Baker to Meet any Claimed Weight.*

The present tolerance allowed for bread is 0.50 oz. on what was formerly the five-cent, but is now the ten-cent loaf.

We will disregard the weights actually claimed, as for C no claim was made, and in the other cases the claim is too much below the actual weights found. Each lot consisted of twelve loaves.

A. If 19 oz. had been claimed three loaves would have varied more than 0.50 oz. (+.051, +0.61 and +1.21).

B. If 16 oz. had been claimed four would have varied more than 0.50 oz. (+1.11, +0.72, +0.51 and +0.54).

C. If 24.5 oz. had been claimed four would have varied more than 0.50 oz. (+1.67, +0.72, +0.76 and +0.83).

D. If 16.5 oz. had been claimed two would have varied more than 0.50 oz. (+0.64 and +0.78).

From the above it appears that the baker in order to meet his claim with certainty must provide a considerable overrun. It does

not seem fair, therefore, to hold him as strictly accountable for excessive weight as for a deficiency. The recommendation is made, therefore, that the tolerance for bread both for the 10 cent and the 15 cent loaves should be not more than 0.50 oz. below or more than 1 oz. above the claimed weight. Applying these tolerances, of the 48 loaves only three would have exceeded the suggested claim by more than 1 oz. and none would have been deficient more than 0.50 oz.

Test of Variations in Weight of Loaves.

Certain bakers have protested against the tolerances in net weight of loaves of bread recognized by our regulations, claiming that unavoidably large variations necessarily followed the use of machines in moulding their bread. To test the accuracy of this claim we weighed a large number of loaves at two bakeries, 150 loaves in the one case, and 67 in the other. The bread was barely warm at the time of weighing, which was about three-quarters of an hour after removal from the ovens. It is unnecessary to give the detailed weighings, but the following is a summary of our results.

Bakery 1.

No. of loaves weighed	150
Lightest loaf	15.4 oz.
Heaviest loaf	17.1 oz.
Average loaf	16.3 oz.
1 loaf weighed	15.4 oz.
30 loaves weighed from	15.5—16.0 oz.
85 loaves weighed from	16.1—16.5 oz.
34 loaves weighed from	16.6—17.1 oz.

With a claim of 16 oz., only 1 loaf would have been more than 0.5 oz. below the claim, and 63 would have been more than 0.5 oz. above the claim; none would have been more than 1 oz. above the claim. The tolerances suggested on a previous page would have amply covered the unavoidable variations at this bakery.

Bakery 2.

No. of loaves weighed	67
Lightest loaf	15.7 oz.
Heaviest loaf	18.6 oz.
Average loaf	17.4 oz.
1 loaf weighed	15.7 oz.
4 loaves weighed from	16.1—16.5 oz.
9 loaves weighed from	16.6—17.0 oz.
29 loaves weighed from	17.1—17.5 oz.

With a claim of 16 oz., none would be more than 0.5 oz. below the claim, 62 would be more than 0.5 oz. above the claim, and 53 would be more than 1 oz. above the claim.

With a claim of 17 oz., 4 would be more than 0.5 oz. below the claim, 24 more than 0.5 oz. above the claim, and 13 more than 1 oz. above the claim.

It is apparent that the first bakery is much more accurate in its scaling than the second. No set of tolerances, which are justifiable, can be established to cover careless and wasteful methods of manufacture. The second bakery, with a claimed weight of 16 oz., apparently is giving the consumer much more bread than the latter has a right to expect from the weight guaranteed. The variations shown in this bakery are no argument against our tolerances. While overweight is no fraud against the consumer, the law requires a relatively accurate statement of net weight on the wrapper, and wide variations from this weight, even though in the consumer's favor, are not in harmony with the spirit of the net weight law. As before suggested, a tolerance of 0.50 oz. below and 1 oz. above the claimed weight seems to be ample for any baker who is willing to take ordinary precautions in scaling his loaves.

BREAKFAST FOODS.

Thirty samples were analyzed, the results of the analyses having been already published in Bulletin 197 of this Station. Below will be found a list of the brands, together with their claimed and actual net weight per package, and their cost.

Brand.	Cost per package, cts.	Net weight. Claimed. oz.	Found. oz.
Albers Wheat Flakes Mush	15	24	24.1
Bestovotes	15	..	19.7
Bran-eat Biscuits, Toasted	15	10	11.4
Bufceco Rolled Oats	10	20	21.1
Capitol Health Bran	15	28	24.1
Cerag	15	10	11.2
Cinnamon Rusks (Peterson)	18	14	12.9
Fruit Nut Cereal	15	11	11.7
Hecker's Cream Hominy	18	24	23.8
Hecker's Cream Oatmeal	10	20	19.9
Jersey Corn Flakes	*10*	*9*	*10.8*
Keen and Robinson's Granulated Scotch Oat-			

Brand.	Cost per package, cts.	Net weight. Claimed. oz.	Found. oz.
Kellogg's Krumbles	10	..	11.5
Malabar Manoca (Bennett, Simpson and Co.).	20	16	16.3
McCann's Irish Oat Meal	35	32	32.9
Mother's Wheat Hearts	15	29	29.7
Pillsbury's Vitos	15	28	30.3
Post Tavern Porridge	18	28	31.9
Purina Sterilized Bran Zos	15	20	21.2
Purity Brand Rolled Oats	10	20	20.7
Quaker Brand Corn Puffs	9	6	7.3
Quaker (FS) Farina	10	14.5	14.9
Quaker Puffed Wheat	15	4	4.3
Ralston Wheat Food	22	24	24.6
Robinson's Patent Groats (in Powder)	50	16	16.3
Scott's Porage Oats	25	32	33.3
Sea Moss Farine	30	4	4.6
Sunbeam Pure Food Pearl Hominy	43	74	73.5
Washington Corn Crisps	10	10	13.7
Zim	15	9	9.2

The only two brands showing any material shortage in weight were *Capitol Health Bran* and *Peterson's Cinnamon Rusks*, which failed to satisfy their claims by 3.9 and 1.1 oz.; respectively.

BROSIA MEALS.

Brosia Meals are made by steam-cooking beans, pease or lentils, freeing them from the hulls and then grinding into meals. They are offered as substitutes for meat and from the standpoint of protein content compare favorably with that food.

Four brands of this product, sold by the Calumet Tea and Coffee Co., Chicago, were analyzed:

9464. *Lentil Brosia Meal*, Cost 25 cts. per lb.

9465. *Pease Brosia Meal*, Scotch, Cost 18 cts. per lb.

9466. *Pease Brosia Meal*, Cost 15 cts. per lb.

9467. *White Bean Brosia Meal*, Cost 18 cts. per lb.

	9464	9465	9466	9467
Water	7.86	8.16	7.16	8.91
Protein (N x 6.25)	29.75	27.00	29.13	24.56
Fat	1.32	1.84	2.63	1.78
Fiber	2.44	1.74	7.63	1.45
Ash	2.80	2.88	3.01	3.61
Nitrogen-free extract	55.83	58.38	50.44	59.69
Starch	41.23	41.85	20.08	35.66
Calories per 100 gms	354	358	342	353

The manufacturer tells us that "Diabetic patients will find lentil or pease or bean meal bread a happy change from gluten bread. Brosia breads contain but a small amount of the starch forbidden to such sufferers." It is true that these four meals contain much less starch than wheat flour and even many so-called gluten flours, but a satisfactory bread cannot be made from them alone, the manufacturer's formula suggesting a substitution of only one-fourth the usual quantity of flour. Breads made by such a formula would still be high in starch, much too high for any diabetic who did not have a very high starch tolerance.

BUTTER.

Of the 14 samples sent by the Dairy Commissioner, 11 were genuine, 2 were oleomargarine and 1 was renovated butter.

CHOCOLATE AND COCOA.

Five samples of these products were analyzed and will be reported in a forth coming Bulletin of this Station. The names of these brands are given below, together with their claimed and actual net weight, and their cost.

	Cost per package, cts.	Net Weight. Claimed.	Net Weight. Found.
Alkethrepta	25	8	8.5
Ghiradelli's Sweet Ground Chocolate and Cocoa	25	8	8.2
Hub Milk Chocolate Sweetened	48	16	16.2
Cocoatina, Anti-Dyspeptic Cocoa	45	8	8.1
Michaelis' Acorn-Cocoa	50	..	7.9

A sample of cocoa sent by the Dairy Commissioner contained no adulteration.

CONDENSED COFFEE.

The analysis of a sample of *Borden's Condensed Coffee Eagle Brand* will be reported shortly in a Bulletin. The net weight of the sample was 15.5 oz., and the cost 35 cents.

COFFEE SUBSTITUTES.

Six brands were tested as follows:

7977. *Drinket*, Kellogg Toasted Corn Flake Co., Battle Creek, Mich. Cost 22 cents for 4 oz.

8112. *Old Grist Mill*, a Substitute for Coffee, Potter and Wrightington, Boston, Mass. "A compound of whole wheat, vegetables, and a small amount of coffee for flavor." Cost 18 cents per 16.6 oz.

9576. *Jaffee*, Beech-Nut Packing Co., Canajoharie, N. Y.; "Made wholly of fruits and grains. Contains no coffee, caffeine or other stimulant." Cost 25 cents per 20.5 oz.

9574. *Postum Cereal*, Postum Cereal Co., Battle Creek, Mich. Cost 25 cents per 16.6 oz.

9463. *Calumet Cereal*, Calumet Tea and Coffee Co., Chicago, Ill.

9462. *Barley Coffee, Whole*, Calumet Tea and Coffee Co., Chicago, Ill.

	7977	**8112**	**9576**	**9574**	**9463**	**9462**
Water	8.04	9.64	9.91	9.11	9.11	6.20
Protein (N x 6.25)	5.69	15.13	11.00	12.38	13.06	10.81
Fat	0.03	3.87	1.66	3.30	4.44	2.73
Fiber	0.04	9.21	9.80	8.64	6.64	5.15
Ash	4.35	3.24	3.91	6.86	3.69	2.99
Nitrogen-free extract	81.85	58.91	63.72	59.71	63.06	72.12
Starch	*	30.38	16.40	19.20	37.97	42.80
Caffein	none	0.17	none	none	0.08	none

* Not determined.

These brands were free from coffee, except Nos. **8112** and **9463**, which contained 0.17 and 0.08 per cent. of caffeine respectively. These amounts, however, are practically negligible, being only one-seventh and one-fifteenth the quantities found in normal coffee.

CREAM.

A sample sent by the Dairy Commissioner contained 36 per cent. of butter fat.

Seven samples of cream were also studied as a basis for identifying homogenized creams, five being straight creams and the other two homogenized. Microscopic examination alone failed to differentiate these with accuracy. The variation in size of the fat globules in our experience did not appear to be as marked as the work of other investigators would indicate.

By allowing 10 cc of the cream, diluted to 100 cc with water, to stand 12 hours in a cylinder, the homogenized samples were

differentiated from the others very strikingly in this series of tests. How reliable the method is, however, can be judged only by further trials.

DIABETIC FOODS.

The following brands were analyzed:

9710. *Ayos, the Improved Soya Bean Flour,* Waukesha Health Products Co., Waukesha, Wis.

9483. *Lister's Diabetic Flour,* self Rising and Strictly Non-Carbohydrate, Lister Bros., New York.

9481. *Longuets de Lausanne,* Manuel Freres.

8768. *Genteel Flour* (manufacturer unknown).

9482. *Cocoa Factory Residue.*

9761. *Spinach Bread.*

	9710	**9483**	**9481**	**8768**	**9482**	**9761**
Water	8.75	11.62	10.78	11.41	8.46	.....
Ash	4.13	2.77	3.04	0.92	7.26	.....
Protein (N x 6.25)	41.44	67.38	14.19	17.13	14.44	.....
Fat	16.87	0.86	5.53	1.96	13.66	.....
Fiber	3.82	0.17	0.44	0.25	12.26	.....
Nitrogen-free extract	24.99	17.20	66.02	68.33	43.92	.....
Starch	0.56	none	49.16	60.52	3.57	44.41

Longuets de Lausanne contain altogether too much starch for a satisfactory diabetic food. *Genteel Flour* is a very inferior gluten flour. The other samples require no special comment.

Two other samples sent by a diabetic were also tested for starch. The first sample was rice that had been boiled three times, the supernatant water being discarded each time; the second was oatmeal porridge which had been washed well, squeezed twice and then boiled. The rice as received contained 83.78 per cent. water and 8.87 per cent. of starch; the oatmeal 82.83 and 3.40 per cent., respectively, indicating a starch reduction in the former of about 34 per cent., and in the latter of about 70 per cent.

FLAVORING EXTRACTS.

Nine samples were examined. These were all of the *Ariston Brand,* made by the Calumet Tea and Coffee Co., Chicago, Ill. The analyses indicate that the extracts are of excellent quality.

Flavor.	Spec. gr. @ 15.6° C.	Alcohol by vol.	Oil by vol.	Color.
Almond	0.8253	92.52	1.16	Normal
Celery	0.8226	92.35	0.73	Normal
Clove	0.8286	89.56	2.95	Normal
Lemon	0.8444	83.17	5.40	Normal
Orange	0.8424	87.45	4.96	Normal
Peppermint	0.8232	91.05	3.20	Normal
Wintergreen	0.8339	88.87	2.94	Normal

The sample of *ginger extract* had a spec. grav. of 0.8238, and contained 89.50 per cent. of alcohol by volume, 0.99 per cent. of solids, 0.93 per cent. of solids soluble in 95 per cent. alcohol, and 0.09 per cent. of solids soluble in cold water.

The sample of *vanilla extract* had a spec. grav. of 0.9750 and contained 39.75 per cent. of alcohol by volume, and 0.20 per cent. of vanillin; the lead number was 0.57, the color was normal and no coumarin was present.

PREPARED FLOURS.

Six samples of this class of food were examined, as follows:

9588. *D. and C. Self-Rising Flour*, The D. and C. Co., New York. " Soft winter wheat flour, grape cream of tartar, phosphate, soda and salt."

9577. *Grandma's Pancake Flour Mixture*, Hecker Cereal Co., New York. " Rice, wheat, corn and leavening materials."

9573. *Presto Self-Raising Flour*, The H-O Co., Buffalo, N. Y. " Leavening and seasoning agents are cream of tartar, bicarbonate of soda, phosphate and salt."

9589. *Reliable Self-Raising Prepared Flour*, Reliable Flour Co., Boston, Mass. " Wheat flour, grape cream of tartar, bicarbonate of soda and salt."

9572. *Swans Down Prepared Cake Flour*, Igleheart Bros., Evansville, Ind. " Not Self Rising."

9578. *Teco, Self-Rising Pancake Flour*, The Ekenberg Co., Cortland, N. Y. " A mixture of wheat and corn flour with malted buttermilk, salt, soda and acid phosphate."

	9588	**9577**	**9573**	**9589**	**9572**	**9578**
Water	12.60	11.56	12.50	12.02	12.66	11.37
Protein (N x 6.25)	9.06	8.50	8.13	9.00	8.50	10.38
Fat	0.91	0.91	0.90	0.68	0.82	1.73
Fiber	0.17	0.27	0.13	0.13	0.13	0.50

	9588	9577	9573	9589	9572	9578
Ash	3.77	4.56	3.56	3.53	0.49	7.21
Nitrogen-free extract	73.49	74.20	74.78	74.64	77.40	68.81
Sodium oxide	1.63	1.54	1.29	1.05	0.13	2.50
Potassium oxid	0.21	0.21	0.36	1.00	0.16	0.42
Phosphoric anhydrid	1.32	1.50	0.88	0.13	0.19	2.29
Sulphuric anhydrid	0.03	0.04	0.10	0.08	0.01	0.11
Chlorin	0.76	0.93	0.82	0.45	trace	0.68
Calcium oxid	trace	0.44	0.30	trace	trace	0.75
Tartrates	(?) none	present	(?) none	present	present	none
Weight claimed, oz	18	18	20	24	36	16
Weight found, oz	18.2	18.0	19.2	23.8	43.5	16.0
Cost per package, cts	14	16	15	20	45	15
Cost per lb., cts	12.3	14.2	12.5	13.5	16.6	15.0

The claims made for these flours seem to be substantiated by our analyses, except that we were unable to detect cream of tartar in Nos. **9588** and **9573.**

FRUIT JUICES.

Five brands of fruit juices were examined as follows:

9587. *Dole's Pure Hawaiian Pineapple Juice*, Hawaiian Pineapple Products Co., Honolulu, Haw. Cost 10 cents per 4.8 fl. oz.

9581. *Du Belle Grape Juice*, Du Belle Grape Juice Co., Rochester, N. Y. "About 2% granulated sugar." Cost 20 cents per 16 fl. oz.

9580. *Hay's Five Fruit*, H. H. Hay Sons, Portland Me. "Strawberries, raspberries, pineapples, oranges, lemons." "1/10 of 1 per cent. sodium benzoate, artificially colored." Cost 40 cents per 16.3 fl. oz.

5582. *Phez*, Pheasant Brand Loganberry Juice, with Sugar, Pheasant Fruit Juice Co., Salem, Ore.

9582. *Tim Pine*, J. Tim Co., New York. "Pineapple juice with sugar added." Cost 25 cents per 15.8 fl. oz.

	9587	9581	9580	5582	9582
Alcohol by volume	0.36	0.26	0.15	0.08	0.12
Solids	13.27	17.87	62.80	34.13	13.54
Ash	0.37	0.38	0.22	.....	0.52
Sucrose	0.16	0.08	1.62	13.48	3.32
Invert sugar	12.95	15.68	59.76	17.87	9.65
Saccharin	none	none	none	none	none

1. * Sodium benzoate 0.08%.

None of the samples contained saccharine or salicylic acid. **9580** contained amaranth color and 0.08 per cent. of sodium benzoate.

HAMBURG STEAK.

Thirty-four samples sent by the Dairy Commissioner were examined for preservatives. None contained boric acid, and five no sulphurous acid. Fifteen samples contained less than 25 mgms. of sulphurous acid per kilogram, while 13 contained this acid in considerable amount as follows:

No.	Sulphurous Acid. mgms. per kilo.	No.	Sulphurous Acid mgms. per kilo.
11637	876.8	11704	368.0
11640	736.0	11706	1740.8
11641	806.4	11707	1875.2
11646	492.8	11710	3513.6
11647	124.8	11712	531.2
11649	2422.4	11721	1628.8
11701	761.6		

These amounts of sulphurous acid are very excessive, and indicate a widespread use of this preservative in comminuted meats that is not without danger to the public health.

No. **11713** had a decided putrid odor when received by us, and was totally unfit for human food.

CORDIALS.

Twenty-seven samples of cordials, brandies and liqueurs have been examined and the results are given in Table XV.

Products of this type have been examined in this laboratory on previous occasions, notably in 1901 and 1914, and their substance and quality need no extended discussion at this time. The solid matter in them consists almost wholly of cane sugar or its derivative, invert sugar, or mixtures of the two sugars. Five samples by their considerable plus polarization at 87° are shown to contain glucose or starch sugar. The coal-tar colors used are of the permitted group except in one case, No. 8155, which contained the unpermitted color magenta. The use of permitted colors does not, however, relieve the manufacturer of the obligation to state the fact of their presence when used. Delinquency in this respect is shown in a number of instances; but in some of these the goods

TABLE XV—ANALYSES OF

Station No.	Brand	Price per bottle, cents
8114	Creme de Menthe Glaciale. P. Garnier, Enghien, France	70
8130	American Creme de Menthe. M. R. Stern, New York	25
8147	Creme de Menthe, in bulk. Johnson Co.,[2] New Haven	25
8149	Creme de Menthe, Liqueur Superfine. Edouard Riviere	10
8151	Creme de Menthe Cordial Superior Quality	20
8158	Creme de Menthe, in bulk	30
8159	Creme de Menthe. Charles Jacquien et Cie	25
8145	Old Abbey Cordialized Apricot Brandy. California Fruit Prod. Co., New York	25
8157	Apricot Cordial. Johnson Co.,[2] New Haven	25
8156	Wild Cherry Cordial. Johnson Co.,[2] New Haven	25
8133	Gilbert's Grenadine Cordial. John Gilbert & Sons, New Haven	35
8146	Anisette Cordial Superior Quality. Hartford Distillery Co., Hartford.	25
8131	Crême de Cèrisès. E. Cusenier, Paris	20
8132	Veritable Cherry Liqueur. E. Cusenier, Paris	20
8139	Meggy-Lelke Weichsel-Cherry Liquor. Schrank Béla es Ödön, Esztergom, Hungary	52
8134	Curacoa Sec. E. Cusenier, Paris	20
8135	Creme de Roses. E. Cusenier, Paris	20
8150	Creme de Rose, Superior Quality. French & Italian Imp. Co., New Haven	10
8153	Creme de Rose. New England Cordial and Importing Co.	20
8136	Grande Liqueur Saint-Martial. P. Bardinet, Bordeaux	20
8137	Kummel. John Gilbert & Son, New Haven	20
8140	Bazilika Ukör, Schrank Béla es Ödön, Esztergom, Hungary	50
8154	Creme de Coffee Cordial. New England Cordial & Importing Co.	20
8155	Creme de Violet. New England Cordial & Importing Co	20
8138	Forbidden Fruit Liqueur. Louis Bustanoby, New York	50
8152	Imperial Peach Cordial. Henry H. Shufeldt & Co., Peoria, Ill	15
8148	Monopol Vodka. Domestic Product. Russian Monopol Co., Brooklyn, N. Y.	15

[1] Napthol Yellow S and Light Green S F Yellowish, permitted coal-tar dyes.
[5] Declared alcohol 42%. [6] Declared artificially colored. [7] Declared alcohol 34%
[10] Polarization @ 87° = +14.4. [11] Polarization @ 87° = +16.0.

were not purchased in the original containers. The alcoholic distillates in all cases were examined for the presence of methyl (wood) alcohol but none was detected. Monopol Vodka is a clear, colorless liquid possessing the odor and taste of raw distilled spirit, which the partial analysis indicates it to be.

INFANT FOODS.

Two well-known brands, not previously examined by this station, were analyzed.

CORDIALS, BRANDIES AND LIQUEURS.

Volume of contents, fl. ozs.	Specific Gravity @ 15.6 °C.	Alcohol by Volume %	Total Solids %	Sucrose %	Reducing Sugar as Invert %	Polarization		Temp. °C.	Color
						Direct °V	Invert °V		
8.3	1.1410	29.30	41.21	40.89	.....	+41.7	—12.5	20	None
6.6	1.1121	18.76	31.85	31.60	.....	+31.8	—10.1	20	N.Y.S&L.G.SFY.[1]
7.3	1.1110	23.86	33.41	19.00	13.48	+15.2	—10.0	20	" "
1.9	1.1056	11.90	28.69	23.34	4.76	+23.7	—7.3	20	" " [6]
2.3	1.0728	20.15	29.94	Present	.....	+43.4	+13.6[3]	19	" "
7.2	1.0718	26.36	25.73	22.70	2.76	+22.3	—7.8	20	" "
7.9	1.1679	15.66	41.22	40.52	.....	+41.0	—12.8	20	" " [6]
7.6	1.1029	28.88	32.05	14.33	17.60	+8.6	—10.3	21	Natural
7.3	1.0940	17.88	27.78	.....	26.98	—7.0	—7.0	21	"
7.5	1.1088	13.60	29.44	7.36	20.00	+1.6	—8.1	21	"
6.9	1.3082	4.76	64.16	.....	61.92	—19.8	—19.8	21	Archil
3.2	1.0385	24.32	16.65	15.33	.....	+15.2	—5.1	21	None
1.7	1.1555	25.50[4]	43.48	31.63	10.50	+28.6	—13.2	21	Natural
1.5	1.0617	25.60	21.12	.....	18.00	—5.8	—6.1	21	"
3.2	1.0994	28.60	32.64	.....	30.72	—8.6	—8.6	21	"
1.1	1.0971	38.70[5]	36.96	35.79	.....	+37.1	—10.2	21	Unidentified[6]
1.6	1.1257	32.25[7]	40.65	39.30	.....	+39.4	—12.5	21	Cudbear[6]
2.5	1.0680	26.20	24.20	Present	.....	+30.0	+7.7[8]	21	Amaranth
2.4	1.0704	25.00	24.41	Present	.....	+31.8	+9.0[9]	21	Amaranth[6]
1.9	1.0935	41.00	37.07	27.39	7.56	+33.0	—3.2	21	None
1.6	1.0823	41.20	35.36	31.47	3.25	+34.0	—7.6	21	None
2.9	1.1068	35.40	36.72	0.74	35.72	—9.2	—10.8	21	Natural
2.3	1.0832	22.95	26.34	Present	.....	+34.8	+12.0[10]	21	Natural
2.5	1.0694	23.95	24.71	Present	.....	+32.6	+9.6[11]	21	Magenta[6]
1.9	1.0549	37.20	27.19	12.26	13.44	+8.2	—8.0	21	Unidentified. Coal-tar
2.4	1.0766	16.20	22.98	1.35	20.28	—6.6	—8.4	20	Vegetable[6]
3.7	0.9463	43.20	.....	.....	.....	.....	....	..	None

[2] Statement: Imported. [3] Polarization @ 87° = +19.2. [4] Declared alcohol 26%
[8] Polarization @ 87° = +13.6. [9] Polarization @ 87° = +15.2.

5576. *Neave's Food for Infants*, J. R. Neave and Co., Fordingbridge, Eng. Wholesale price 30 cents per 16 oz.

5577. *Savory and Moore's Food for Infants and Invalids*, Savory and Moore, London, Eng. Wholesale price 27 cents per 10 oz.

	5576	**5577**
Water	8.81	6.28
Ash	0.60	0.75
Protein (N x 6.25)	6.94	11.75

	5576	5577
Fat	1.19	1.45
Fiber	0.21	0.12
Nitrogen-free extract	82.25	79.65
Starch	70.42	69.19

Neave's Food is essentially a baked flour, while the *Savory and Moore Food* is composed of wheat flour and malt. Both brands contain very large percentages of starch. Owing to the diastatic ferment present most of the starch in *Savory and Moore's Food*, if prepared according to directions, would be converted into soluble forms, chiefly dextrins. In *Neave's Food* such would not be the case as no ferment is present.

JELLY AND JUNKET POWDERS.

The descriptions of three new brands and their analyses follow:

9570. *Falconjel, Raspberry.* Falcon Packing Co., New York. "Composed of geletine, sugar, citric acid, artificial flavor and vagetable color." Cost 13 cts. per 6.3 oz.

9568. *Jiffy-Jell, Orange.* Waukesha Pure Food Co., Waukesha, Wis. "A mixture, vegetable color." Cost 13 cts. per 3.3 oz.

9569. *Nesnah, Lemon Flavor.* The Junket Folks, Little Falls, N. Y. "Contains U. S. certified color." Cost 10 cts. per 4.0 oz.

	9570	9568	9569
Water	2.43	3.28	0.15
Ash	0.15	0.21	0.35
Gelatin (N x 5.55)	7.66	8.05	none
Cane sugar	88.35	88.11	98.82
Undetermined	1.41	0.35	0.68
Color	*	**	***

* Lichen color, probably cudbear. ** Cochineal. *** Napthol Yellow S and Orange I.

These three samples substantially satisfy their claims, although of course it is incorrect to class cochineal as a "vegetable" color. *Nesnah* contained rennin or a rennet-like substance.

Granting the convenience of such preparations, purchasing sugar in the form of a jelly powder is rather an expensive practice.

MILK.

Three hundred and ninety samples sent by the Dairy Commissioner were analyzed. Of these 132 conformed to the legal

TABLE XVI.—WATERED MILKS.

No.	Dealer.	Solids.	Fat.
	Bloomfield:		
12302	F. Chiaramonti..	11.08	3.6
12199	J. Viicciaido.....	8.09	2.6
12300	" "	8.99	3.0
12301	" "	9.12	3.0
	East Lyme:		
11679	Koss Bros.......	11.21	3.6
	Guilford:		
12133	Frank Haggerty..	11.66	3.7
12136	R. E. Scranton...	11.26	3.9
12138	" " ..	11.23	3.6
12139	Willard Scranton.	10.57	3.0
12140	" "	11.08	3.9
	Jewett City:		
11854	W. B. Frink, Est.	11.40	3.5
11855	" " "	11.73	3.7
	Killingly:		
12111	Walter Chase....	11.02	3.6
11650	(Unknown)......	8.15	2.5
	Meriden:		
12089	W. A. Reed.....	10.28	3.0
12090	" "	10.59	3.1
	Noroton:		
12029	James H. Mead..	11.60	4.6
12030	" " "	10.20	4.0
	No. Franklin:		
12268	J. Ries..........	12.07	4.2
	Norwich:		
11653	J. J. Harrington..	10.23	3.4
11654	" "	9.95	3.0
11655	" "	10.29	3.2
11656	" "	10.19	3.2
11399	(Unknown)......	10.11	2.8
	Orange:		
12144	E. J. Cronin.....	10.25	3.1
11730	S. G. Grillo......	3.72	1.3
12143	Wasily Paray....	8.18	2.4
	Shelton:		
11939	P. Imbimbo.....	11.28	4.3
	Southbury:		
11981	J. N. Benson....	11.62	4.1
11975	H. B. Davis.....	6.20	2.1
11976	" "	9.07	2.4
11978	E. Mellane......	12.05	4.3
11979	Mrs. Nora Rogers	8.76	2.3
11980	" " "	11.90	4.0
	So. Norwalk:		
11772	J. H. Crosby....	10.87	3.2
12132	J. H. Wempe.....	11.12	3.4
	Stonington:		
12152	J. B. Crowley....	11.24	3.3
	Watertown:		
12018	A. Brazee.......	11.30	3.5
	Westport		
11973	Robt. Dykman...	11.65	3.9
11974	" "	11.65	3.8
	Willimantic:		
12173	G. W. Andrews..	11.01	3.1
11669	Reinstein Bros...	9.41	2.9
	Woodbury:		
11946	T. Madin.......	11.43	3.6
12000	B. F. Ricker....	10.52	3.2

standards, 216 were below the standard in one or more respects, 44 were watered, 6 were skimmed and 2 were both skimmed and watered. Of the sub-standard samples, in which no watering or skimming was detected, 9 were deficient in fat, 3 in solids and fat, 118 in solids-not-fat, 42 in solids and solids-not-fat, and 44 in solids, fat and solids-not-fat. The large proportion of adulterated and sub-standard samples is no indication of the quality of the milk generally sold in this state, as all of these samples were taken because of some suspicion as to their purity. That there is an abundance of milk of good quality sold in the state is shown by the composition of the 132 samples which conformed to the standards. These contained from 11.75 to 14.49 per cent. of

solids and from 3.3 to 6.0 per cent. of fat, with averages of 12.61 and 4.03 per cent., respectively. In 57 per cent. of these samples the fat ranged from 3.3 to 4.0, in 30 per cent. from 4.0 to 4.5, in 7 per cent. from 4.5 to 5.9, and in 6 per cent. was over 5.0 per cent.

Table XVI shows the composition of the watered milks and the names of the dealers selling them.

The following tabulations give similar data for the skimmed and the skimmed and watered milks:

SKIMMED MILKS.

No.	Dealer.	Solids.	Fat.
12161	Mansfield Center: H. E. Avery	11.98	3.2
11691	S. J. Nacsin	10.95	2.6
12169	No. Franklin: J. Ries	11.17	2.8
11457	Southington: W. S. Crosby	10.97	2.6
12130	Sterling: Richard Fortune	11.74	2.8
11391	Willimantic: (unknown)	12.50	3.1
	SKIMMED AND WATERED MILKS.		
12027	Noroton: T. M. Collins	8.12	2.2
11875	Somers: E. H. Pease	9.60	2.1

SAUSAGE.

Twenty-one samples of pork sausage, sent by the Dairy Commissioner, were tested for added starch. In sixteen of these the starch ranged from 0.16 to 0.39 per cent. In the remaining five samples the percentages were much higher, indicating that starch had been added to the sausage meat. The adulterated samples were as follows:

No.	Dealer.	Starch. %
11724	Thos. Rutendo, Hartford	4.63
11731	Meriden Market, Meriden	2.75
11735	Fulton Market, Waterbury	2.55
11738	Palace Market, Waterbury	1.64
11739	Public Market, Waterbury	2.43

SPICES.

In 1916 we inspected spices sold in package form; this year the inspection has been concerned chiefly with bulk goods. Fifty-two samples, sent by the Dairy Commissioner, have been examined.

Applying the standards rigidly 1 sample of black pepper, 10 of cayenne, 4 of cloves, 2 of ginger and 1 of white pepper departed

TABLE XVII.—SPICES.

No.	Dealer.	Ash. Total.	Ash. Insol. in acid.	Starch.	Crude fiber.	Non-volatile ether extract.
	Black Pepper.					
11784	James Van Dyk Co., New York (New Haven store)	6.43	1.40	36.03	11.47	7.72
11802	Ross W. Weir & Co., New York (W. B. Eastman, New Milford)	6.17	1.11	33.96	12.69	8.19
11783	In bulk (F. H. Davis, New London)	6.35	1.35	36.62	12.26	7.90
11788	" " (Flemming & Cowan, Hartford	**7.12**	1.15	28.41	15.00	8.31
11795	" " (M. Epstein, So. Norwalk)	6.76	1.30	36.84	11.76	7.51
11798	" " (W. F. Brennan, Torrington)	5.31	0.71	39.60	11.06	7.29
11806	" " (Geo. B. Clark, Salisbury)	5.07	0.57	37.57	12.16	7.13
11829	" " (Direct Importing Co., New Haven)	5.73	0.65	41.65	9.93	6.80
11840	" " (Pure Food Market, New Haven)	6.72	1.26	32.76	13.95	8.70
11900	" " (Yale Tea & Coffee Co., Waterbury)	4.56	0.25	34.11	13.52	6.51
	Cayenne Pepper.					
11793	East India Tea Co. (So. Norwalk store)	5.57	0.20	0.62	22.12	17.83
11800	McCormick & Co., Baltimore (Jos. Gaven, Torrington)	**7.50**	**1.52**	1.43	24.08	**10.02**
11782	In bulk (W. F. Barrows, New London)	6.17	**0.57**	1.27	25.94	16.34
11790	" " (Newton, Robertson & Co., Hartford)	**6.61**	**0.65**	0.73	24.40	17.00
11797	" " (A. Davey & Co., So. Norwalk)	6.30	**0.52**	1.07	24.39	16.41
11803	" " (Geo. B. Clark, Salisbury)	**7.43**	**1.11**	0.53	25.15	10.22
11824	" " (Direct Importing Co., Mystic)	6.44	0.50	0.51	19.34	15.00
11830	" " (" " " Bridgeport)	6.37	0.48	0.96	20.65	**13.51**
11833	" " (Village Store Co., Bridgeport)	**7.81**	**0.62**	0.67	24.43	**14.87**
11835	" " (Union Pacific Tea Co., Bridgeport)	**6.97**	**1.20**	1.07	25.65	15.68
11836	" " (Mohican Co., New Haven)	6.06	0.15	0.70	21.39	19.21
11837	" " (Shartenberg & Robinson Co., New Haven)	5.35	0.15	1.17	18.82	**12.36**
11838	" " (Direct Importing Co., New Haven	6.32	0.10	1.07	14.85	**11.11**
11841	" " (Pure Food Market, New Haven)	6.42	0.40	0.87	21.91	16.61
11842	" " (F. J. Markle, New Haven)	5.60	0.38	0.81	24.76	16.82
11844	" " (Grand Union Tea Co., New Haven)	5.81	0.50	0.81	25.11	16.73
11847	" " (Yale Tea & Coffee Co., Waterbury)	**8.56**	**0.72**	1.46	27.73	**3.94**
	Cloves.					
11786	In bulk (S. Satriano, Hartford)	6.26	0.25	..	8.33	17.80
11792	" " (James Butler, Stamford)	6.55	0.32	...	9.42	14.21
11799	" " (W. F. Brennan, Torrington)	6.79	0.60	...	**13.88**	**6.40**
11826	" " (Direct Importing Co., Mystic)	6.25	0.48	...	9.08	17.34
11827	" " (Gager Crawford Co., New London)	5.96	0.27	...	**10.73**	14.81
11839	" " (John Gilbert & Son, New Haven)	7.62	**0.57**	...	8.17	19.86
11845	" " (Carlson Tea Co., New Haven)	6.42	0.39	...	9.79	15.12
11848	" " (Yale Tea & Coffee Co., Waterbury)	6.82	**0.71**	...	9.55	16.90
	Ginger.					
11787	In bulk (S. Satriano, Hartford)	5.12	0.93	49.56	...	...
11794	" " (M. Epstein So. Norwalk)	4.90	0.57	48.66	...	...
11801	" " (H. M. Hoag, Sharon)	5.11	0.70	51.36	...	...
11805	" " (Geo. B. Clark, Salisbury)	**6.51**	0.52	49.90	...	...

Figures in boldface indicate a departure from the standard.

TABLE XVII.—SPICES—*Continued.*

No.	Dealer.	Ash. Total.	Ash. Insol. in acid.	Starch.	Crude fiber.	Non-volatile ether extract.
	Ginger.					
11807	In bulk (F. S. Roberts, New Hartford)	5.17	0.90	49.05	...	...
11828	" " (Direct Importing Co., New Haven)	**6.50**	0.62	48.26	...	...
11831	" " (" " " Bridgeport)	5.57	0.66	49.44	...	...
11843	" " (Pure Food Market, New Haven)	5.95	1.00	49.05	...	...
11846	" " (Great Atl. & Pac. Tea Co., Waterbury)	4.60	0.27	51.52	...	...
11849	" " (Yale Tea & Coffee Co., Waterbury)	4.01	0.46	52.73	...	...
	White Pepper.					
11789	Chas. G. Lincoln & Co. (Brown, Thomson & Co., Hartford)	1.21	0.15	55.46	4.27	7.52
11785	In bulk (Buckley & Reardon, Hartford)	1.22	0.13	53.72	3.93	7.10
11791	" " (James Butler, Stamford)	2.03	0.50	55.23	4.38	7.96
11796	" " (Andrew Davey & Co., So. Norwalk)	1.17	0.10	55.74	4.39	7.31
11804	" " (Geo. B. Clark, Salisbury)	1.49	0.06	58.61	4.05	7.04
11825	" " (Direct Importing Co., Mystic)	**5.16**	**0.52**	47.24	**7.57**	7.49
11834	" " (Davey Bros., Bridgeport)	1.01	0.07	55.25	3.76	6.97

Figures in boldface indicate a departure from the standard.

from the standard in some respect. Many of these variations, however, are trivial, and only the following seven can be considered as seriously adulterated:

Cayenne pepper. Nos. **11800, 11803, 11837, 11838** and **11847.**

Cloves. No. **11799.**

White pepper. No. **11825.**

The spices sold in Connecticut market, both in package form and in bulk, are on the whole of satisfactory quality. The adulterations found are due chiefly either to insufficient cleaning of the crude spices, or to careless storage conditions whereby the spice value of the product is impaired.

TEMPERANCE BEVERAGES.

The quite general enactment of laws prohibiting the sale and even the use of intoxicating drinks, makes the analysis of beer substitutes a matter of some importance. Four such brands have been examined this year as follows:

8163. *Anzac Cereal Beverage,* Anzac Co., Boston, Mass. Cost 10 cts. per 12 fl. oz.

TABLE XVIII.—VINEGAR.

No.	Brand.	Acidity.	Solids.
	Cider Vinegar.		
11909	A. & P.	4.44	1.91
11926	American Grocers Society. (A. G. S.)	4.01	1.99
11922	Apple Product Co.	4.01	2.32
11923	Berkshire Products Co.	4.00	1.82
12050	" " "	3.86	1.78
12032	A. C. Blenner & Co.	4.04	1.93
11914	W. W. Cary & Son.	4.32	2.08
11919	" " "	4.20	2.09
12038	Cascade Cider Co (C. C. C.)	4.66	2.31
11910	John T. Doyle Co. (Country Club)	4.24	1.90
11935	Lewis DeGroff & Son (Health)	5.12	2.29
11920	Duffy Malt Co. (Duffy's Gold Seal)	4.04	1.98
12036	Eagle Oil & Supply Co. (Sumner)	4.00	1.74
11912	Empire Bottling Works (Empire)	4.01	1.76
11924	Empress Mfg. Co. (Howard)	4.00	1.94
11925	Glautz & Sulkind (G. & S.)	4.57	2.03
12037	Humphrey & Cornell	4.06	1.90
11933	Francis H. Leggett & Co. (Premier)	5.12	2.72
12043	D. E. Mowry Co.	4.60	1.92
12042	Pen Yan Cider Co. (Parson's)	4.80	2.60
11918	Rocco	4.32	1.91
12011	Scutonia	2.04	2.97
11917	Silver Boy Packing Co.	4.28	2.21
12061	Silver Lane Pickling Co.	4.60	2.30
11934	Standard Pickle Co.	4.16	1.83
12063	J. A. Thompson & Son (XXX)	3.84	1.93
12044	R. C. Williams & Co. (Robin Hood)	5.46	2.20
12010	E. H. Woodworth	3.98	1.60
11944	" "	4.00	1.64
11915	Sold by W. R. Bailey, New Haven	4.72	3.26
12031	" " B. Halpert, New Haven	4.00	2.00
12034	" " Kobler Bros., New Haven	4.24	2.48
12035	" " E. Casher & Son, New Haven	3.98	1.81
12039	" " E. J. Bates, New London	4.24	1.70
12041	" " A. Wachanasky, New London	5.18	2.04
12062	" " A. Fronz, Meriden	4.04	1.88
12060	" " G. Galamandra, Meriden	3.72	1.98
12064	" " J. A. Collins, Meriden	3.28	3.27
	Distilled Vinegar.		
12040	Sold by A. Gordon, New London	4.04	0.25
	Distilled and Molasses Vinegar.		
11913	John T. Doyle Co.	3.96	0.36

8161. *Bevo*, Non-Intoxicating, Anheuser-Busch Brewing Association, St. Louis, Mo. Cost 12 cts. per 10 fl. oz.

9162. *Iron Brew*, Non-Alcoholic, The Mass and Waldstein Extract Co., Newark, N. J. "Colored with burnt sugar." Cost 5 cts. per 7.3 fl oz.

9590. *Wesco*, Temperance Beverage Co., Pelham, N. Y. "Alcohol less than ½ per cent." Cost 15 cts. per 11.5 fl. oz.

	8163	8161	8162	9590
Alcohol by volume	0.42	0.38	0.38	0.44
Solids	5.92	6.20	8.37	4.91
Ash	0.21	0.11	0.10	0.18
Direct reducing sugars	2.27	2.42	6.90	1.55
Total reducing sugars	5.41	5.79	7.72	4.15

No saccharin, benzoic or salicylic acids were found in any of the above.

VINEGAR.

Forty samples sent by the Dairy Commissioner were examined. The state standard for vinegar sets limits only for acidity and solids, 4.00 and 1.60 per cent., respectively, and only these determinations were made in this examination. Thirty-five samples satisfied the standard, and five were deficient in acidity, the percentages found ranging from 2.04 to 3.84.

MISCELLANEOUS FOODS.

EGGS. Six samples of eggs, sent by the Dairy Commissioner, and purchased for "fresh eggs," were found to be misbranded.

SUGAR. Of four samples of granulated sugar, sent by the Dairy Commissioner, three were pure, but the fourth contained about 3.5 per cent. of corn starch. A sample of brown sugar from the same source contained 86.87 per cent. of saucrose, and was not adulterated.

OVALTINE. *Ovaltine, Tonic Food Beverage.*. A. Wander, London, Eng. "A concentrated extraction from malt, milk and eggs, flavored with cocoa." "Is rich in lecithin, the assimilable organic compound of phosphorus. It is thus a valuable article of food in cases of mental and nervous exhaustion."

Water	1.03
Ash	3.52
Protein (N x 6.25)	12.75
Fat	5.58
Fiber	0.64
Nitrogen-free extract	76.48
Lecithin phosphoric acid	0.10
Reducing sugars (chiefly maltose, lactose, dextrose and dextrins)	70.01

Active amylase	present
Starch	trace
Calories per 100 gms	407

The product appears to be composed of the foods claimed. The small amount of lecithin phosphoric acid present, 0.10 per cent, hardly seems to justify the claim that the food is " rich in lecithin," or that it is " a valuable article of food in cases of mental and nervous exhaustion."

TAPIOCA. *Sunbeam Pure Food Small Pearl Tapioca, German Sago Style.* Austin, Nichols and Co., New York. Cost 12 cts. per 14 oz.

Water	13.51
Ash	0.16
Protein (N x 6.25)	0.56
Fat	0.05
Fiber	0.05
Starch	85.67
Calories per 100 gms	345

COTTEN SEED BREAD. This is a " war " bread, made according to the following recipe for one loaf:

⅔ cupful cotton seed meal
2⅓ cupfuls bread flour
1 teaspoonful salt
1 tablespoonful sugar
½ cake yeast
1 cupful lukewarm liquid (water, milk, or equal parts of each).

Its composition follows and that of baker's bread for comparison.

We are indebted for the above recipe and sample to the Bureau of Chemistry, U. S. Department of Agriculture.

WHEAT-A-LAXA BREAD. Made by the S. S. Thompson Co., New Haven. " Natural Grain, Laxative, Whole Wheat."

BISCUITS. Three samples were analyzed as follows:

8122. *Homo Whole Wheat Biscuit,* National Biscuit Co., New York, Cost 10 cts. for 66 biscuits weighing 5.9 oz.

8129. *Whole Wheat Crackers,* Loose-Wiles Biscuit Co., Boston, Mass. Cost 15 cts. for 7.4 oz.

8125. *India Biscuit* (formerly *India Digestive Biscuit*), New England Cereal Co., South Norwalk, Conn. Cost 25 cts. for 20 biscuits weighing 11 oz.

	Cotton Seed Bread.	Wheat Bread.	Wheat-A Laxa Bread.	8122	8129	8125
Water	38.02	36.44	33.60	9.56	10.23	8.67
Ash	2.09	1.43	2.17	3.47	3.18	5.02
Protein	13.51	7.65	8.60	9.13	9.13	12.81
Fat	1.63	1.98	3.75	8.10	4.33	2.24
Nitrogen-free extract	*44.75*	*62.60*	*61.90*	69.10	72.80	66.03
Fiber	...	...	...	0.64	0.33	5.23
Calories per 100 grams	248	258	276	386	367	336

NUT MARGARINE. *Nut Margarine, Coco-Nut Brand,* The Nucoa Butter Co., New York " Free from animal fats." " Contains 1-10 per cent of benzoate of soda." Cost 30 cts. per lb.

Water	7.65
Sodium benzoate	0.10
Reichert-Meissl No.	7.25
Refractive index @ 40° C.	1.4502

Phytosterol, cocoanut oil and possibly peanut oil were present, cholesteral and cotton seed oil were not present.

The product consists chiefly of cocoanut oil with possibly some peanut oil. No animal fat is present. This is a wholesome preparation and at present butter prices might well be substituted for that article. The presence of benzoate of soda is objectionable as well as unnecessary.

FLOUR. *Good Health Flour,* A. B. Klar, Canal Dover, O. " Contains muscle, brain, nerve, bone and tooth elements."

Water	12.01
Ash	1.68
Protein (N x 6.25)	15.13
Fat	3.30
Fiber	1.62
Nitrogen-free extract	66.26
Starch	53.83
Phosphoric acid	0.86
Calories per 100 gms	355

Any good whole wheat flour justifies the above claim quite as well as this particular brand.

OYSTERO. *Oystero,* Oyster Broth Powder, J. S. Darling and Son, Hampton, Va. Carton containing three tubes weighing [illegible]ether about 0.5 oz., and each claimed to be " sufficient to make [illegible] of oyster broth," cost 25 cts.

Water	3.77
Ash	11.39
Protein (N x 6.25)	52.50
Fat	9.20
Nitrogen-free extract	23.14
Sodium chlorid	3.10
Boric acid	none

The above analysis agrees well with that of dried oyster meat and the preparation appears to be true to name.

GRISSIN. *Piemont Toreador Grissin, Salted, Italian Bread Sticks*, A. Angononoa, New York. Cost 13 cts. per 3.7 oz.

SPLIT PEAS. *Mission Garden Split Peas.* Cost 36 cts. per 32.0 oz.

	Grissin.	Split Peas.
Water	10.10	11.33
Ash	3.59	2.88
Protein (N x 6.25)	11.50	23.44
Fat	7.21	1.01
Fiber	0.21	1.06
Nitrogen-free extract	67.39	60.28
Chlorin	1.39	...
Calories per 100 grams	380	344

RYZON, The Perfect Baking Powder, General Chemical Co., New York. "Monosodium phosphate, sodium bicarbonate, starch." Cost 18 cts. per 8.6 oz. It contained moisture 4.08, phosphoric acid 22.96, carbonic acid 12.73, residual carbonic acid 0.45, available carbonic acid 12.28, sodium oxid 20.32, sulphuric anhydrid 0.22, starch 31.68 per cent., calcium oxid a trace. It is composed, therefore, of about 38.80 per cent. monosodium phosphate, 24.3 sodium bicarbonate, 31.7, starch, 0.4 sodium sulphate, 4.08 moisture and 0.74 undertermined.

8120. *Vegex*, A Vegetable Extract, J. W. Beardsley's Sons, New York, "Made entirely of vegetable products. Contains 35% protein." Cost 25 cts. per 2 oz.

8121. *Vegex Cubes;* same manufacturer as above. Cost 15 cts. per box of 12 cubes, each weighing 0.16 oz.

	8120	8121
Moisture	28.24	7.22
Protein (N x 6.25)	33.00	18.88
Ash	25.73	64.59
Chlorin	7.86	34.59

	8120	8121
Sodium chlorid	12.96	57.02
Creatinin	none	none
Nitrates	none	none

8127. *Kremette Ice Cream Dressing,* G. F. Heublein and Bro., Hartford. "A Delicious and Palatable Adjunct to Vanilla Ice Cream. Artificially colored." "Alcohol 20%." Price 35 cts. per 6.1 fl. oz.

Spec. grav. @ 15.6° C.	1.1609
Alcohol by volume	20.52
Solids	43.24
Sucrose	35.49
Invert sugar	6.40
Ash	0.02
Color	archil or cudbear

8115. *Feinste Schlag-Sahne* (*Sterilized Whipped Cream*), C. Mäden Stubben, Bremen, Germany. "Absolutely pure and free of all ingredients." (Evidently an erroneous translation.) Cost 14 cts. per 8 oz.

Water	62.22
Solids	37.78
Ash	0.56
Protein (N x 6.25)	2.52
Lactose	2.25
Fat	32.05
Borax, benzoate, and salicylate	none

THE DRYING OF VEGETABLES BY MEANS OF THE ELECTRIC FAN.

The drying of vegetables and fruits by artificial heat or by the sun's heat is an old practice, but recently in the effort to conserve food of a perishable nature, drying by means of an unheated current of air from an electric fan has been recommended.

While the method has certain advantages, for instance, a better preservation of flavor and color, doubts rose in our minds as to the keeping qualities of products thus prepared. Accordingly we have tested the method with a number of vegetables, with the following results. For comparison several samples were also dried with artificial heat and one by exposure to the sun.

The drying period which has been recommended generally is

far too short. During our first tests the weather conditions were very unfavorable for successful drying, and our drying periods were longer than would have been required in less humid weather.

After drying, the vegetables were conditioned for a few days as directed, and were then placed in card-board boxes which were tightly wrapped in paraffined paper. The contents of the boxes were examined at first at two-week, later at monthly intervals for the presence of mold or insect infestation.

1. *Rhubarb*, June 1. Thoroughly washed, superficial moisture removed with a clean towel, and the stalks cut into 1–16 in. slices. Dried 15¾ hrs., probably unnecessarily long. In good condition Nov. 7.

2. *Rhubarb*, June 1. Treated as above but dried with artificial heat. dried 16⅔ hrs. In good condition Nov. 7.

3. *Asparagus tips*, June 2. Asparagus washed, surplus moisture removed, and tougher more fibrous portion cut away and dried separately. Tips cut into ½ in., fibrous part into ⅛ in. pieces. Drying very prolonged, as sample was not cut fine enough, and the air was exceedingly humid. Insect infestation noted on Oct. 2.

4. *Asparagus, fibrous part*, June 2. Prepared as above, and dried with artificial heat. In good condition Nov. 7.

5. *Asparagus tips*, June 2. Treated as in No. 4. In good condition Nov. 7.

6. *Carrots*, June 2. Sliced very thin, about 1/32 in.* Dried in 3 hrs. In good condition Nov. 7.

7. *Spinach*, June 13. Thoroughly washed, and passed through a slicer, stems and all. Stems proved very hard to dry and were later removed. Dried in about 10 hrs. Slight mold shown on Oct. 2.

8. *Spinach*, June 13. Treated as No. 7, but dried with artificial heat in about 3 hrs. Slight mold shown on Oct. 2.

9. *Spinach*, June 13. Whole leaves, dried with heat. After several hours drying it was necessary to remove the leaf stems. In good condition Nov. 7.

10. *String beans*, June 18. Beans were stringed, washed and blanched in boiling water for 10 min. They were then drained and cut lengthwise for drying. Drying very prolonged. Mold developed after one month.

10a. *String beans*, June 18. Same as No. 10, except that beans were cut crosswise into 1 in. pieces. Drying very prolonged. Badly molded on June 30.

11. *String beans*, June 18. Treated same as No. 10, except that artificial heat was used. Drying very prolonged. In good condition Nov. 7.

12. *String beans*, June 18. Treated same as No. 10a, except that artificial heat was used. Drying very prolonged. In good condition Nov. 7.

13. *Swiss chard*, June 26. Leaves sliced fine, the chopped stems being

COMPOSITION OF DRIED VEGETABLES.

No.		Water.	Ash.	Protein. (N x 6.25).	Fiber.	Nit.-free extract.	Fat.
1	Rhubarb, fan	16.70	13.00	13.06	11.35	43.83	2.06
2	Rhubarb, heat	13.55	12.98	13.94	13.41	44.68	1.44
3	Asparagus tips, fan	19.69	8.13	32.06	7.74	30.54	1.84
4	Asparagus, fibrous, heat	15.90	7.57	17.31	14.97	43.18	1.07
5	Asparagus tips, heat	16.51	8.32	33.31	8.32	31.04	2.50
6	Carrots, fan	15.41	7.54	8.63	7.92	60.10	0.40
7	Spinach, fan	9.96	22.00	30.88	8.74	25.55	2.87
8	Spinach, heat	9.34	22.22	30.50	9.22	24.99	3.73
9	Spinach, whole leaves, heat	10.54	19.65	29.63	5.81	29.51	4.86
10	String beans, long, fan	15.57	6.91	18.38	13.99	44.37	1.78
11	String beans, long, heat	12.86	6.32	20.19	11.72	47.06	1.85
12	String beans, short, heat	13.60	6.36	20.00	12.01	46.36	1.67
13	Swiss chard, fan	13.25	20.68	24.06	8.14	30.47	3.40
14	Swiss chard, sun	12.74	20.71	24.63	6.44	32.01	3.47
15	Swiss chard, heat	12.72	14.81	28.63	6.43	32.69	4.72
16	Peas, fan	14.12	3.38	24.25	5.71	51.38	1.16
17	Peas, fan	14.01	4.00	27.50	8.58	43.34	2.57
18	Baked beans, fan, heat	7.70	3.19	24.50	4.55	58.90	1.16

kept separate. Leaves dried in 6 hrs., stems taking longer. In good condition Nov. 7.

14. *Swiss chard*, June 26. Treated same as No. 13, but dried in greenhouse with sun's heat. Drying much slower than with fan. In good condition Nov. 7.

15. *Swiss chard*, July 8. Leaves stripped from stems and the whole leaves dried with heat. Dried in about 6 hrs. In good condition Nov. 7.

16. *Peas*, July 12. Peas shelled and passed through meat grinder. Dried in about 7 hrs. Insect infestation found on Oct. 2.

17. *Peas*, July 13. Treated as No. 16. Dried in 12 hrs., somewhat over dried. Insect infestation found on Sept. 1.

18. *Baked beans*. Beans baked, then dried with fan and current of hot air. In good condition Nov. 7.

To summarize, we find that only 3 of 9 samples dried without heat by the electric fan were in good condition after from 4 to 5 months, while 8 of 9 samples dried with artificial heat and the one sample dried with the sun's heat were free from mold and insect infestation at the end of the same period. On the whole our short experience, therefore, is unfavorable to the cold air, electric fan method of drying.

That the dried vegetables possess high nutritive value is shown the following analyses of our products. By adding the following parts of water to one part of the dried vegetable the resultant

product would have about the same moisture content as the fresh vegetable: Baked beans, 3, peas 3.5, rhubarb 14, carrots, 7 asparagus 14, spinach 11, Swiss chard 11 and string beans 8 parts.

II. DRUG PRODUCTS.

DRUGS FROM STOCK OF DISPENSING PHYSICIANS.

In the Report for 1916 the analyses of 53 such samples were reported. On the following pages will be found the results with 76 additional samples, completing our first inspection of this class of products.

The names and addresses of the firms represented are shown below:

Bristol Myers Co., Brooklyn, N. Y.
Brewer and Co., Worcester, Mass.
Buffington Pharm. Co., Worcester, Mass.
Daggett and Miller Co., Providence, R. I.
Direct Sales Co., Buffalo, N. Y.
Drug Products Co., New York.
The G. F. Harvey Co., Saratoga Springs, N. Y.
The Harvey Co., Saratoga Springs, N. Y.
Independent Pharm. Co., Worcester, Mass.
C. Killgore, New York.
Maltbie Chemical Co., Newark, N. J.
Moore and Co., Worcester, Mass.
National Drug Co., Philadelphia, Pa.
Norwich Pharmacal Co., Norwich, N. Y.
P. J. Noyes Co., Lancaster, N. H.
The E. L. Patch Co., Boston, Mass.
Polk Calder Co., Troy, N. Y.
Progressive Chemical Co., New Haven, Conn.
Surgeon and Physicians Supply Co., Boston, Mass.
Tailby-Nason Co., Boston, Mass.
The Tracy Co., New London, Conn.
John Wyeth and Bro., Philadelphia, Pa.
Yates Drug and Chemical Co., New York.

In the case of tablets at least half of the number making up the sample were weighed individually. These were then ground into a composite sample and the mixture analyzed. In certain instances only the active drug or drugs were determined, while in others a complete analysis was made.

TABLETS.

Acetasol.

11592. *Acetasol*, made by Daggett and Miller Co.; stock of Dr. F. Schavoir, Stamford. *Claimed;* Acetanilid 50%, caffein

2.5%, sodium salicylate, sodium bicarbonate, sugar of milk and oil of wintergreen q.s. to make 100. *Found;* Weights of 19 tablets ranged from 345.9 to 363.4, average, 353.2 mgms. They contained 44.06% acetanilid, 2.12 caffein, 13.36 sodium bicarbonate and 7.36 sodium salicylate; milk sugar and oil of wintergreen present.

Tablets deficient in acetanilid and caffein.

Ammonium Salicylate Comp.

11588. *Ammonium Salicylate Comp.*, made by Daggett and Miller Co.; stock of Dr. J. G. Stanton, New London. *Claimed per tablet;* Ammonium salicylate 2 grs., caffein 1 gr., camphor ½ gr., acetanilid 1⅓ grs., and Dover's powder 1½ grs. *Found;* Weights of 20 tablets ranged from 405.2 to 454.8, average 425.5 mgms. They contained 27.12% ammonium salicylate, 13.42 caffein and 19.27 acetanilid; camphor present and opium and ipecac (indicating Dover's powder).

Tablets contained in part

	Ammonium Salicylate. grs.	Caffein. grs.	Acetanilid. grs.
Heaviest	1.90	0.94	1.35
Lightest	1.70	0.84	1.21
Average	1.78	0.88	1.26

Tablets deficient in ammonium salicylate and caffein.

Antiseptic Tablets.

11577. *Antiseptic Tablets No. 2*, made by Daggett and Miller Co.; stock of Dr. J. W. Callahan, Norwich. *Claimed per tablet;* Corrosive sublimate 7 grs., citric acid 3.48 grs. *Found;* Weights of 12 tablets ranged from 569.8 to 666.2, average, 603.4 mgms. They contained 56.24% corrosive sublimate, or from 4.94 to 5.78, average, 5.24 grs.

Tablets very variable in weight, all short weight, and deficient in corrosive sublimate.

11619. *Antiseptic Tablets No.* 1, made by Direct Sales Co., stock of Dr. T. F. O'Loughlin, Rockville. *Claimed per tablet;* Corrosive sublimate 7.3 grs., ammonium chlorid 7.7 grs. *Found;* Weights of 12 tablets ranged from 970.8 to 1016.8, average, 983.9 mgms. They contained 47.23% corrosive sublimate, or from 7.08 to 7.41, average 7.17 grs.

Tablets satisfactory.

11558. *Antiseptic Tablets No.* 1, made by the Tracy Co.; stock of Dr. T. J. Connors, West Haven. *Claimed per tablet;* Corrosive sublimate 7.3 grs., ammonium chlorid 7.7 grs. *Found;* Weights of 12 tablets ranged from 1061.9 to 1083.9, average, 1073.3 mgms. They contained 46.57% corrosive sublimate, or from 7.63 to 7.79, average, 7.72 grs.

Tablets satisfactory.

11625. *Alkaline and Antiseptic Tablets* (*Dr. Seiler's Formula*), made by National Drug Co.; stock of Dr. E. J. Thompson, Hartford. *Claimed per tablet;* Sodium bicarbonate, sodium biborate, sodium benzoate, sodium salicylate, sodium chlorid, eucalyptol, thymol, menthol, oil of sweet birch. *Found;* Weights of 13 tablets ranged from 834.2 to 883.1, average, 863.2, mgms. No specific amounts being claimed only qualitative tests were made. Sodium borate, carbonate, chlorid, salicylate, benzoate and thymol and menthol were found.

Tablets satisfactory in respect to ingredients.

11447. *Antiseptic Germicide*, made by the Maltbie Chemical Co.; stock of Dr. J. L Gilday, Bridgeport. *Claimed per tablet;* Mercuric iodid 3/8 grs., potassium iodid 3/8 gr., sodium bicarbonate 6 grs. *Found;* Weights of 12 tablets ranged from 1040.8 to 1152.6, average 1096.1, mgms. They contained 2.03* mercuric iodid, 2.88 potassium iodid and 94.25 per cent. sodium bicarbonate; so that one tablet contained

	Mercuric iodid. grs.	Potassium iodid. grs.	Sodium bicarbonate. grs.
Heaviest	0.361	0.512	16.88
Lightest	0.326	0.463	15.14
Average	0.343	0.487	15.94

Tablets satisfactory except for large excess of sodium bicarbonate. It is possible, however, that the sampling agent erroneously copied 6 for 16 grs.

Arsenious Iodid Compound.

11445. *Arsenious Iodid Compound*, made by Drug Products Co.; stock of Dr. C. L. Dichter, Stamford. *Claimed per tablet;* Corrosive sublimate 1-64 gr., potassium iodid 2 grs., syr. iron iodid 5 min., sol. arsenic and mercury iodid 2 min., tinct. nux vomica 2 min. *Found;* Weights of 24 tablets ranged from 497.2 to 559.5, average, 534.6, mgms. They contained 5.21 potassium

and 17.10 per cent. iodin; mercury, arsenic and iron present; sample too small for identification of nux vomica. Based on the potassium content, tablets contained 22.12 per cent. potassium iodid, so that heaviest tablet contained 1.91 grs., lightest, 1.70, average, 1.82.

Tablets slightly deficient in potassium iodid.

Aspirin Tablets.

11587. *Aspirin Tablets,* made by Daggett and Miller Co.; stock of Dr. J. S. Stanton, New London. *Claimed per tablet;* 5 grs. *Found;* Weights of 12 tablets ranged from 422.5 to 447.0, average, 434.1, mgms. They contained 53.65% aspirin, or from 3.50 to 3.70, average, 3.59 grs.

Tablets deficient in aspirin.

11567. *Aspirin Tablets,* made by National Drug Co.; stock of Dr. S. H. Holmes, Jewett City. *Claimed per tablet;* 5 grs. *Found;* Weights of 12 tablets ranged from 339.0 to 356.0, average 347.1, mgms. They contained 84.90% aspirin, or from 4.44 to 4.66, average, 4.55 grs.

Tablets passed.

11563. *Aspirin Compound,* made by the P. F. Noyes Co.; stock of Dr. F. M. Dunn, New London. *Claimed per tablet;* Aspirin 1¼ grs., strontium salicylate 2 grs., acetphenetidin 1 gr., caffein ¼ gr., colchicin 1-200 gr., oil of wintergreen, q.s. *Found;* Weights of 20 tablets ranged from 368.5 to 400.5, average, 385.0, mgms. They contained 18.54 aspirin, 30.78 strontium salicylate, 14.10 acetphenetidin and 3.80 per cent. caffein; oil of wintergreen present and an alkaloid but insufficient for identification as colchicin.

One tablet contained in part

	Aspirin. grs.	Strontium salicylate. grs.	Acetphenetidin. gr.	Caffein. gr.
Heaviest	1.15	1.90	0.87	0.235
Lightest	1.05	1.75	0.80	0.216
Average	1.10	1.83	0.84	0.226

Tablets slightly deficient in aspirin, strontium salicylate and acetphenetidin.

Blaud's Compound.

11572. *Blaud Pills Compound No.* 6, made by Independent armaceutical Co.; stock of Dr. E. P. Douglass, Groton. *Claimed*

per pill; Arsenious acid 1/60 gr., strychnin sulphate 1/60 gr., corrosive sublimate 1/60 gr., powdered capsicum 1/64 gr. extr. gentian 1/16 gr., Blaud's mass 5 grs. *Found;* Weights of 24 pills ranged from 577.8 to 646.2, average, 613.3, mgms. They contained 15.45 ferrous carbonate and 0.16 per cent. arsenious acid; capsicum and strychnin sulphate (impure residue=0.19%) present; mercury present but material insufficient for determination.

One pill contained in part

	Ferrous carbonate. grs.	Arsenious acid. gr.	Strychnin sulphate (impure). gr.
Heaviest	1.54	0.0160	0.0189
Lightest	1.38	0.0143	0.0169
Average	1.46	0.0151	0.0180

Tablets passed.

11593. *Blaud's Compound Tablets No.* 7, made by National Drug Co.; stock of Dr. F. Schavoir, Stamford. *Claimed per tablet;* Extr. nux vomica 1/10 gr., Blaud's mass 5 grs., arsenious acid 1/60 gr., extr. cascara sagrada 1 gr., manganese binoxid 1 gr. *Found;* Weights of 24 tablets ranged from 680.1 to 725.5, average, 703.5, mgms. They contained 8.30 ferrous carbonate, 0.15 arsenious acid, and 8.73 per cent. manganese binoxid; cascara and strychnin present (impure alkaloidal residue=0.20%).

One tablet contained in part

	Ferrous carbonate. gr.	Arsenious acid. gr.	Maganese binoxid. gr.
Heaviest	0.93	0.0168	0.98
Lightest	0.87	0.0157	0.92
Average	0.90	0.0163	0.95

Tablets satisfactory.

Bronchitis Tablets.

11585. *Bronchitis No.* 6, made by C. Killgore; stock of Dr. F. E. Wilcox, Willimantic. *Claimed per tablet;* Creosote 1 min., strychnin sulphate 1/60 gr., terpen hydrate 2 grs., eucalyptol ½ gr. *Found;* Weights of 20 tablets ranged from 461.2 to 535.4, average, 499.6 mgms. They contained 0.23 strychnin sulphate and approximately 22.60 per cent. terphen hydrate; creosote and possibly eucalyptol present.

One tablet contained in part:

	Strychnin Sulphate. gr.	Terpen hydrate (approx.) grs.
Heaviest	0.0190	1.87
Lightest	0.0164	1.61
Average	0.0177	1.74

Tablets probably slightly deficient in terpen hydrate.

Calcreose.

11552. *Calcreose No. 2*, made by the Maltbie Chemical Co.; stock of Dr. C. K. Heady, Milford. *Claimed per tablet;* Calcreose (a powder containing approximately 5% of beechwood creosote in chemical combination with calcium) 4 grs., reduced iron ½ gr., arsenic trioxid 1/150 gr., strychnin 1/150 gr. *Found;* Weights of 20 tablets ranged from 570.0 to 621.4, average, 590.9 mgms. They contained calcium oxid 8.92, reduced iron 6.33, arsenic trioxid 0.038, ash 29.91, talc 3.14, strychnin not over 0.035 and creosote approximately 15.38 per cent.

The amounts of arsenic and strychnin are much higher than claimed.

Calomel Tablets.

11575. *Calomel Tablet Triturates*, made by Buffington Pharmacy Co.; stock of Dr. R. E. Black, New London. *Claimed per tablet;* Calomel 1/10 gr., flavored with wintergreen. *Found;* Weights of 26 tablets ranged from 70.7 to 86.2, average, 77.1, mgms. They contained 8.10 per cent. of calomel, or from 0.089 to 0.109, average 0.097 gr.

Tablets satisfactory.

11573. *Calomel Tablets*, made by Drug Products Co.; stock of Dr. W. A. Hillard, Pawcatuck. *Claimed per tablet;* Calomel 1/10 gr., flavored with spearmint. *Found;* Weights of 25 tablets ranged from 72.7 to 89.4, average, 76.7 mgms. They contained 8.42 per cent. of calomel, or from 0.094 to 0.116, average, 0.099 gr.

Tablets satisfactory.

11627. *Calomel Tablet Triturates*, made by the Harvey Co.; stock of Dr. G. F. Lewis, Stratford. *Claimed per tablet;* Calomel 1 gr. *Found;* Weights of 25 tablets ranged from 111.5 to 126.8, average, 119.9 mgms. They contained 49.37 per cent. of calomel, or from 0.85 to 0.97, average, 0.91 gr.

Tablets passed.

11611. *Calomel Tablets* (*Calomets*), made by Moore and Co.;

stock of Dr. E. M. Hamblin, Bristol. *Claimed per tablet;* Calomel 1/10 gr. *Found;* Weights of 25 tablets ranged from 28.2 to 38.4, average, 36.2 mgms. They contained 16.85 per cent. of calomel, or from 0.068 (a single light tablet) to 0.109, average, 0.094 gr.

Tablets satisfactory.

11568. *Calomel Tablet Triturates,* made by National Drug Co.; stock of Dr. S. H. Holmes, Jewett City. *Claimed per tablet;* Calomel 1/10 gr. *Found;* Weights of 25 tablets ranged from 73.6 to 87.2, average, 79.3 mgms. They contained 7.94 per cent. of calomel, or from 0.091 to 0.107, average, 0.097 gr.

Tablets satisfactory.

11559. *Calomel Tablet Triturates,* made by E. L. Patch Co.; stock of Dr. H. Stendel, Ansonia. *Claimed per tablet;* Calomel, 1 gr. *Found;* Weights of 25 tablets ranged from 134.2 to 148.8, average, 141.2 mgms. They contained 45.28 per cent. of calomel, or from 0.94 to 1.04, average, 0.99 gr.

Tablets satisfactory.

11609. *Calomel Tablets,* made by Tailby-Nason Co.; stock of Dr. W. R. Hanrahan, Bristol. *Claimed per tablet;* Calomel 2 grs. *Found;* Weights of 18 tablets ranged from 153.2 to 169.5, average, 161.7 mgms. Tablets contained 69.34 per cent. of calomel, or from 1.64 to 1.82, average, 1.73 grs.

Tablets deficient in calomel.

11586. *Calomel Tablets,* stock of Dr. T. R. Parker, Willimantic; **11603**, stock of Dr. C. A. Hamilton, Waterbury; **11557**, stock of Dr. T. J. Connors, West Haven; all made by Yates Drug and Chemical Co. *Claimed per tablet;* Calomel 1/10 gr. *Found;* In **11586** weights of 25 tablets ranged from 84.5 to 98.5, average, 94.9 mgms. They contained 6.62 per cent. of calomel, or from 0.086 to 0.101, average, 0.097 gr. In **11603** weights of 25 tablets ranged from 90.1 to 110.9, average, 106.3 mgms. They contained 6.30 per cent. of calomel, or from 0.088 to 0.108, average, 0.103 gr. In **11557** weights of 25 tablets ranged from 90.0 to 99.6, average, 95.8 mgms. They contained 7.04 per cent. of calomel, or from 0.098 to 0.108, average, 0.104 gr.

Tablets in the three samples satisfactory.

11595. *Calomel Tablets,* stock of Dr. W. Burke, Greenwich; **11614,** stock of Dr. N. A. Burr, Manchester; both made by Yates Drug and Chemical Co. *Claimed per tablet;* Calomel 1/4 gr.

Found; In **11595** weights of 25 tablets ranged from 90.1 to 100.9, average, 96.8 mgms. They contained 16.23 per cent. of calomel or from 0.226 to 0.253, average, 0.242 gr. In **11614** weights of 25 tablets ranged from 86.2 to 95.5, average, 91.1 mgms. They contained 17.16 per cent. of calomel, or from 0.228 to 0.252, average, 0.242 gr.

Tablets in both samples satisfactory.

Calomel and Soda Tablets.

11571. *Calomel and Soda Tablet Triturates No.* 3, made by Independent Pharmaceutical Co.; stock of Dr. E. P. Douglass, Groton. *Claimed per tablet;* Calomel 1/4 gr., sodium bicarbonate 1 gr. *Found;* Weights of 25 tablets ranged from 116.5 to 130.2, average, 124.3 mgms. They contained 12.52 calomel and 57.46 per cent. sodium bicarbonate, so that one tablet contained:

	Calomel. gr.	Sodium bicarbonate. grs.
Heaviest	0.252	1.15
Lightest	0.225	1.03
Average	0.240	1.10

Tablets are satisfactory.

11570. *Calomel Compound Tablet Triurates No.* 6, made by E. L. Patch Co.; stock of Dr. J. H. McLoughlin, Jewett City. *Claimed per tablet;* Calomel 1/2 gr., sodium bicarbonate 1/2 gr. *Found;* Weights of 25 tablets ranged from 150.0 to 166.9, average, 160.3 mgms. They contained 19.74 calomel and 74.93 per cent. sodium bicarbonate, so that one tablet contained:

	Calomel gr.	Sodium bicarbonate. grs.
Heaviest	0.509	1.93
Lightest	0.456	1.73
Average	0.488	1.85

Tablets satisfactory, the claim for sodium bicarbonate probably having been copied incorrectly.

11606. *Calomel and Soda Tablets,* made by Yates Drug and Chemical Co.; stock of Dr. J. Gaucher, Waterbury. *Claimed per tablet;* Calomel 1/10 gr., sodium bicarbonate 1 gr. *Found;* Weights of 25 tablets ranged from 121.9 to 129.6, average, 126.5 ... They contained 5.34 calomel and 51.14 per cent. sodium **11611**.te, so that one tablet contained:

	Calomel. gr.	Sodium bicarbonate. grs.
Heaviest	0.107	1.02
Lightest	0.100	0.96
Average	0.104	1.00

Tablets satisfactory.

Cascara Compound.

11607. *Cascara Compound No.* 3, made by E. L. Patch Co.; stock of Dr. R. J. Lawton, Terryville. *Claimed per tablet;* Cascarin ¼ gr., aloin ¼ gr., podophyllin 1/6 gr. extr. belladonna ⅛ gr., strychnin sulphate 1/60 gr., gingerine ⅛ gr. *Found;* Weights of 25 tablets ranged from 165.9 to 199.6, average, 181.5 mgms. They contained aloin, ginger, resins (probably podophyllin) and probably cascara; no tests were made for belladonna alkaloids; no calomel present; 0.56 per cent. of total alkaloids chiefly strychnin. Heaviest tablet contained 0.0172, lightest 0.0143, average 0.0157 gr. of strychnin.

Tablets satisfactory.

Cathartic Compound.

11578. *Cathartic Compound,* made by Daggett and Miller Co.; stock of Dr. J. N. Callahan, Norwich. *Claimed per tablet;* Extr. colocynth Co. 1¼ grs., calomel 1 gr., jalap resin 1/3 gr., powdered gamboge ¼ gr. *Found;* Weights of 17 tablets ranged from 410.2 to 443.9, average, 430.3 mgms. They contained 14.60 per cent. of calomel, a large amount of resinous material, aloes and a bitter principle (colocynth), the aloes indicating the presence of Extr. colocynth Co. The tablets contained from 0.92 to 1.00, average, 0.97 gr. of calomel.

Tablets satisfactory.

11452. *Cathartic Compound,* made by National Drug Co.; stock of Dr. T. Martino, Hartford. *Claimed per tablet;* Extr. colocynth Co., 1¼ grs., calomel 1 gr., jalap resin 1/8 gr., powdered gamboge ¼ gr. *Found;* Weights of 20 tablets ranged from 320.0 to 346.1, average, 332.0 mgms. They contained 14.60 per cent. of calomel, a large amount of resinous material, aloes and a bitter principle (colocynth), the aloes indicating the presence of Extr. colocynth Co. The tablets contained from 0.72 to 0.78, average, 0.75 gr. of calomel.

Tablets deficient in calomel.

Cold Tablets.

11576. *Cold Tablets*, made by Buffington Pharmacy Co.; stock of Dr. R. E. Black, New London. *Claimed per tablet;* Acetanilid 1½ grs., powdered opium 3/20 grs., camphor monobrom 1/3 gr., caffein citrated ½ gr., cascara sagrada ½ gr. *Found;* Weights of 20 tablets ranged from 252.8 to 269.6, average, 263.1 mgms. They contained 33.40 acetanilid and 12.16 per cent. of caffein citrated U. S. P.; powdered opium, camphor monobrom and cas·ara present. One tablet contained in part:

	Acetanilid. grs.	Caffein citrated, U. S. P. gr.
Heaviest	1.39	0.51
Lightest	1.30	0.47
Average	1.36	0.49

Tablets deficient in acetanilid.

11618. *Cold Tablets No. 2 (Dr. Gage)* made by Moore and Co.; stock of Dr. T. E. O'Loughlin, Rockville. *Claimed per tablet;* Powdered capsicum ¼ gr., tinct. aconite 1 min., quinin sulphate 2 grs. and Dover's powder 2 grs. *Found;* Weights of 20 tablets ranged from 415.4 to 462.2, average, 446.4 mgms. They contained 28.77 per cent. quinin sulphate; capsicum, Dover's powder (opium and ipecac) present; no test made for aconitin. They contained from 1.84 to 2.05, average, 1.98 grs. quinin sulphate.

Tablets satisfactory so far as tested.

Hammond's Tonic.

11560. *Triturate Tablets Tonic (Dr. Hammond)*, made by E. L. Patch Co.; stock of Dr. H. Stendel, Ansonia. *Claimed per tablet;* Iron pyrophosphate ½ gr., quinin sulphate ½ gr., strychnin sulphate 1/120 gr. *Found;* Weights of 20 tablets ranged from 95.8 to 100.8, average, 98.9 mgms. They contained 23.90 total alkaloids, 6.12 iron and 11.24 per cent. phosphoric acid; quinin and strychnin present as sulphates; material insufficient for quantitative separation of the small amount of strychnin. Iron pyrophosphate is an indefinite salt, but judging from the relation between the iron and phosphoric acid found the tablets contained from 19 to 20 per cent. of anhydrous iron pyrophosphate.

Tablets passed as probably satisfactory.

Headache Tablets.

11608. *Acetanilid Comp. Tablets*, made by Brewer and Co.; 11of Dr. W. R. Hanrahan, Bristol. *Claimed per tablet;* Acetan-

ilid 3.5 grs., caffeine 0.5 grs., sodium bicarbonate 1 gr. *Found;* Weights of 15 tablets ranged from 452.7 to 477.8, average, 462.3 mgms. They contained 47.52 acetanilid, 6.80 caffeine and 13.94 per cent. sodium bicarbonate, so that one tablet contained:

	Acetanilid. grs.	Caffein. gr.	Sodium bicarbonate. grs.
Heaviest.......	3.50	0.50	1.03
Lightest.......	3.32	0.48	0.97
Average.......	3.39	0.49	0.99

Tablets satisfactory

11626. *Acetanilid Comp. Tablets, No.* 4, made by National Drug Co.; stock of Dr. E. J. Thompson, Hartford. *Claimed per tablet;* Acetanilid 3½ grs., sodium bicarbonate 8/10 gr., sodium bromid 1/10 gr., caffeine citrated ½ gr. *Found;* Weights of 15 tablets ranged from 375.9 to 403.9, average, 389.2 mgms. They contained 57.93 acetanilid, 15.46 sodium bicarbonate, 1.46 sodium bromid and 8.24 per cent. citrated caffeine U. S. P., so that one tablet contained:

	Acetanilid. grs.	Sodium bicarbonate. gr.	Sodium bromid. gr.	Caffein citrated, U. S. P. gr.
Heaviest.......	3.61	0.96	0.091	0.51
Lightest.......	3.36	0.90	0.085	0.48
Average.......	3.48	0.93	0.088	0.50

Tablets passed, although slightly deficient in sodium bromid.

11444. *Acetanilid Comp. Tablets No.* 17, made by National Drug Co.; stock of Dr. C. L. Dichter, Stamford. *Claimed per tablet;* Acetanilid 3 grs., sodium bicarbonate 2 grs., caffeine citrated ½ gr., camphor monobrom ½ gr., acid tartaric 1/8 gr., fl. ex. gelsemium 1 min., oil of cinnamon q. s. *Found;* Weights of 12 tablets ranged from 438.5 to 459.8, average, 446.1 mgms. They contained 43.16 acetanilid, 7.20 citrated caffein U. S. P., and 28.45 per cent. sodium bicarbonate; camphor monobrom, tartaric acid, oil of cinnamon and gelsemium present, so that one tablet contained in part:

	Acetanilid. grs.	Citrated caffein, U. S. P. gr.	Sodium bicarbonate. grs.
Heaviest.......	3.06	0.51	2.02
Lightest.......	2.92	0.49	1.93
Average.......	2.97	0.50	1.96

Tablets satisfactory.

11622. *Migrain Tablets No. 2*, made by E. L. Patch Co.; stock of Dr. T. F. Rockwell, Rockville. *Claimed per tablet;* Acetanilid 2 grs., caffein citrated 0.5 gr. camphor monobrom 0.5 gr. *Found;* Weights of 20 tablets ranged from 227.2 to 254.4, average, 240.3 mgms. They contained 54.26 acetanilid and 13.32 per cent. citrated caffein U. S. P. camphor monobron present; so that one tablet contained:

	Acetanilid. grs.	Citrated caffein, U. S. P. gr.
Heaviest	2.13	0.52
Lightest	1.90	0.47
Average	2.01	0.49

Tablets satisfactory.

11620. *Migrain Tablets No. 3*, made by Surgeons and Physicians Supply Co.; stock of Dr. T. F. O'Loughlin, Rockville. *Claimed per tablet;* Acetanilid 2 grs., caffein citrated 0.5 gr., camphor monobrom 0.5 gr. *Found;* Weights of 15 tablets ranged from 298.7 to 349.8, average, 328.8 mgms. They contained 36.20 acetanilid and 8.92 per cent. citrated caffein, U. S. P.; camphor monobrom present; so that one tablet contained:

	Acetanilid. grs.	Citrated caffein, U. S. P. gr.
Heaviest	1.95	0.48
Lightest	1.77	0.41
Average	1.84	0.45

Tablets passed.

11583. *Migrain Tablets*, made by Tailby-Nason Co.; stock of Dr. T. Soltz, New London. *Claimed per tablet;* Acetanilid 2 grs., caffein citrated 0.5 gr., camphor monobrom 0.5 gr. *Found;* Weights of 20 tablets ranged from 198.4 to 233.4, average, 223.0 mgms. They contained 58.03 acetanilid and 14.36 per cent. citrated caffein, U. S. P.; camphor monobrom present; so that one tablet contained:

	Acetanilid. grs.	Citrated caffein, U. S. P. gr.
Heaviest	2.09	0.52
Lightest	1.78	0.44
Average	2.00	0.50

Tablets satisfactory.

11601. *Migrain Tablets*, made by Tailby-Nason Co.; stock of Dr. C. Rowling, New Haven. *Claimed per tablet;* Acetanilid

2 grs., caffein 0.25 gr., camphor monobrom 0.5 gr. *Found;* Weights of 20 tablets ranged from 202.6 to 230.6, average, 221.2 mgms. They contained 57.94 acetanilid and 7.18 per cent. caffein; camphor monobrom present; so that one tablet contained:

	Acetanilid. grs.	Caffein. gr.
Heaviest.................	2.06	0.26
Lightest.................	1.81	0.22
Average.................	1.98	0.24

Tablets satisfactory.

11605. *Headache Tablets* (Dr. F. J. Hawley), made by Yates Drug and Chemical Co.; stock of Dr. J. Caucher, Waterbury. *Claimed per tablet;* Acetanilid 2.5 grs., aromatic powder 0.5 gr., sodium bicarbonate 1 gr., caffein 0.5 gr., camphor 0.1 gr., oil quassia q. s. *Found;* Weights of 15 tablets ranged from 341.6 to 362.7, average, 330.6 mgms. They contained 46.61 acetanilid, 8.90 caffein and 19.16 per cent. sodium bicarbonate; volatile oil, aromatics and camphor present; so that one tablet contained:

	Acetanilid. grs.	Caffein. gr.	Sodium bicarbonate. grs.
Heaviest.......	2.61	0.50	1.07
Lightest.......	2.46	0.47	1.01
Average.......	2.52	0.48	1.04

Tablets satisfactory.

Hexamethylene Tetramine Tablets.

11598. *Hex-uro-gen*, made by Daggett and Miller Co.; stock of Dr. H. L. F. Locke, Hartford. *Claimed per tablet;* Hexamethylenamine 5 grs., acid sodium phosphate 5 grs. *Found;* Weights of 12 tablets ranged from 676.9 to 706.7, average, 694.7 mgms. They contained 51.80 hexamethylene tetramine and 42.16 per cent. of acid sodium phosphate, so that one tablet contained:

	Hexamethylene tetramine. grs.	Acid sodium phosphate. grs.
Heaviest.................	5.65	4.60
Lightest.................	5.41	4.41
Average.................	5.55	4.52

Tablets satisfactory.

11612. *Hexaform Tablets*, made by Yates Drug and Chemical Co.; stock of Dr. A. S. Brackett, Bristol. *Claimed per tablet;* Hexaform 5 grs. *Found;* Weights of 12 tablets ranged from 311.8

to 338.2, average, 323.6 mgms. They contained 99.75 per cent. hexamethylene tetramine, or from 4.80 to 5.21, average, 4.98 grs. per tablet.

Tablets satisfactory.

Hypophosphites Compound.

11599. *Tabs. Hypophosphites Compound Improved,* made by Daggett and Miller Co.; stock of Dr. H. L. F. Locke, Hartford. *Claimed per tablet;* Iron hypophosphite 3/8 gr., manganese hypophosphite ¼ gr., quinin hypophosphite 1/6 gr., calcium hypophosphite ¼ gr., potassium hypophosphite 3/8 gr., strychnin hypophosphite 1/64 gr., arsenious acid 1/50 gr., cascarin 1/8 gr. *Found;* Weights of 25 tablets ranged from 150.2 to 177.9, average, 161.4 mgms. They contained 2.05 iron, 2.42 manganese, 1.04 calcium, 3.57 potassium, 10.82 phosphorus and 0.51 per cent. arsenious acid; quinin, strychnin and hypophosphites present. The claimed amounts of the various hypophosphites require 3.31 per cent. iron, 2.95 manganese, 2.34 calcium and 5.59 potassium, with 17.37 total phosphorus. Our analysis shows only about 62 per cent. of the required phosphorus and deficiencies in iron, manganese, calcium and potassium.

Tablets below strength claimed.

Iodized Calcium.

11449. *Calcium Iodized,* made by Daggett and Miller Co.; stock of Dr. S. M. Garlick, Bridgeport. *Claimed per tablet;* Calcium iodized 1 gr. *Found;* Weights of 25 tablets ranged from 91.5 to 111.0, average, 101.7 mgms. They contained 3.09 per cent. total iodin, 0.26 available iodin, 14.20 total calcium oxid and 3.28 calcium iodid (calculated from the non-available iodin). The tablets, therefore, contained from 1/227 to 1/270, average, 1/244 gr. available iodin and from 1/18 to 1/22, average, 1/20 gr. calcium iodid.

No standard for comparison.

La Grippe Saratoga Tablets.

11624. *La Grippe Saratoga Tablets,* made by the Harvey Co.; stock of Dr. J. B. Waters, Hartford. *Claimed per tablet;* Acetanilid 1¾ grs., caffein citrated ½ gr., ipecac, 1/20 gr., quinin salicylate ½ gr., capsicum 1/10 gr., podophyllin 1/40 gr., aloin 1/40 gr. *Found;* Weights of 15 tablets ranged from 350.2 to 405.9, average,

380.4 mgms. They contained 31.11 acetanilid, 8.96 citrated caffein U. S. P., 6.32 total alkaloids and 2.45 per cent. salicylic acid (probably as quinin salt); capsicum, quinin salicylate, aloin, podophyllin and ipecac powder present; so that one tablet contained in part:

	Acetanilid. grs.	Citrated Caffein, U. S. P. gr.
Heaviest	1.95	0.56
Lightest	1.68	0.48
Average	1.83	0.53

Tablets quite variable in weight, but satisfactory as regards average composition.

Mercury Protoiodid Tablets.

11602. *Mercury Protoiodid Tablets*, made by Polk Calder Co.; stock of Dr. M. D. Slattery, New Haven. *Claimed per tablet;* Mercury protoiodid ¼ gr., charcoal 1/10 gr., aromatics q.s. *Found;* Weights of 25 tablets ranged from 97.0 to 102.5, average, 99.1, mgms. They contained 15.22 per cent. of mercury protoiodid, or from 0.228 to 0.240, average, 0.233 gr. per tablet.

Tablets satisfactory.

Mixed Treatment.

11453. *Mixed Treatment* (*Dr. Sherwell*), made by National Drug Co.; stock of Dr. T. Martino, Hartford. *Claimed per tablet;* Corrosive sublimate 1/64 gr., potassium iodid 2 grs. syr. iron iodid 5 min., liq. arsenic and mercury iodid 2 min., tinct. nux vomica 3 min. *Found;* Weights of 20 tablets ranged from 497.4 to 532.4, average, 514.6, mgms. They contained 5.75 potassium and 20.06 per cent. iodin; mercury, arsenic and iron present; insufficient sample to confirm presence of nux vomica. Based on the potassium percentage tablets contained 24.41 per cent. potassium iodid, so that heaviest contained 2.01, lightest 1.87, average, 1.94 grs.

Tablets passed.

Myalgie (Dr. Harvey).

11566. *Myalgie* (*Dr. Harvey*), made by Daggett and Miller Co.; stock of Dr. G. E. Bradford, New London. *Claimed per tablet;* Sodium salicylate 2 grs., acetanilid 2 grs., cerium oxalate ½ gr., caffein citrated ½ gr. *Found;* Weights of 20 tablets ranged from 382.2 to 419.4, average, 406.6, mgms. They contained

21.26 sodium salicylate, 25.30 acetanilid, 4.92 citrated caffein U. S. P., and 7.10 per cent. cerium oxalate; so that one tablet contained

	Sodium Salicylate. grs.	Acetanilid. grs.	Citrated caffein, U. S. P. gr.	Cerium Oxalate. gr.
Heaviest	1.38	1.64	0.32	0.46
Lightest	1.26	1.50	0.29	0.42
Average	1.33	1.59	0.31	0.45

Tablets deficient in sodium salicylate, acetanilid and citrated caffein.

Neuralgie No. 5.

11610. *Neuralgie No.* 5, made by Yates Drug and Chemical Co.; stock of Dr. E. M. Hamblin Bristol. *Claimed per tablet;* Acetanilid 2 grs., aconitin 1/100 gr., strychnin muriate 1/120 gr., quinin muriate 1 gr. *Found;* Weights of 15 tablets ranged from 309.5 to 324.2, average, 317.9, mgms. They contained 39.60 acetanilid and 17.50 per cent. total alkaloids; quinin, strychnin and chlorids present; no test made for aconitin.

One tablet contained in part

	Acetanilid. grs.	Total Alkaloids. gr.
Heaviest	1.98	0.875
Lightest	1.89	0.837
Average	1.94	0.659

Tablets passed.

Phenolphthalein Tablets.

11581. *Phenolphthalein Tablets,* stock of Dr. N. B. Lewis, Norwich; **11589,** stock of Dr. G. A. Shelton, Shelton; both made by the G. F. Harvey Co. *Claimed per tablet;* Phenolphthalein 2 grs. *Found;* In **11581** weights of 24 tablets ranged from 276.9 to 303.9, average, 287.2, mgms. They contained 48.46 per cent. phenolphthalein, or from 2.07 to 2.27, average, 2.15, grs. per tablet. In **11589** weights of 20 tablets ranged from 288.7 to 305.2, average, 297.3 mgms. They contained 43.13 per cent. phenolphthalein, or from 1.92 to 2.03, average, 1.98 grs. per tablet.

Tablets in both samples satisfactory.

Phenolphthalein and Calomel Tablets.

11621. *Phenolphthalein and Calomel Tablets,* made by Tailby-Nason Co.; stock of Dr. T. F. Rockwell, Rockville. *Claimed per*

tablet; Phenolphthalein 1/10 gr., calomel 1/10 gr. *Found;* Weights of 25 tablets ranged from 90.9 to 109.2, average, 102.5, mgms. They contained 6.94 per cent. phenolphthalein and 6.56 calomel, so that one tablet contained

	Phenolphthalein. gr.	Calomel. gr.
Heaviest	0.117	0.111
Lightest	0.097	0.092
Average	0.110	0.104

Tablets satisfactory.

Quinin Sulphate Tablets.

11615. *Quinin Sulphate Tablets,* made by Tailby-Nason Co.; stock of Dr. W. S. Gillam, South Manchester. *Claimed per tablet;* Quinin sulphate 2 grs. *Found;* Weights of 15 tablets ranged from 312.0 to 336.9, average, 322.6 mgms. They contained 38.41 per cent. quinin sulphate, or from 1.85 to 2.00, average, 1.91, grs. per tablet.

Tablets satisfactory.

11623. *Quinin Sulphate Tablets,* made by John Wyeth and Bro.; stock of Dr. J. B. Waters, Hartford. *Claimed per tablet;* Quinin sulphate 2 grs. *Found;* Weights of 20 tablets ranged from 256.6 to 280.0, average, 266.3, mgms. They contained 44.06 per cent. quinin sulphate, or from 1.74 to 1.90, average, 1.81 grs. per tablet.

Tablets deficient in quinin sulphate.

11590. *Quinin Sulphate Tablets,* made by Yates Drug and Chemical Co.; stock of Dr. G. A. Shelton, Shelton. *Claimed per tablet;* Quinin sulphate 2 grs. *Found;* Weights of 20 tablets ranged from 210.0 to 234.5, average 225.3 mgms. They contained 62.18 per cent. quinin sulphate, or from 2.01 to 2.25, average, 2.16 grs. per tablet.

Tablets satisfactory.

Quinin and Nux Vomica Tablets.

11600. *Quinin and Nux Vomica Tablets,* made by Tailby-Nason Co.; stock of Dr. C. Rawling, New Haven. *Claimed per tablet;* Quinin sulphate 1 gr., extr. nux vomica 1/10 gr. *Found;* Weights of 20 tablets ranged from 175.9 to 195.3, average, 186.1 mgms. They contained 32.79 per cent. quinin sulphate; nux vomica

alkaloids present but not determined. Tablets contained in part from 0.89 to 0.99, average, 0.94 gr. quinin sulphate per tablet.

Tablets satisfactory.

Sodium Bromid Tablets.

11574. *Sodium Bromid Tablets*, made by Buffington Pharmacy Co.; stock of Dr. E. A. Hillard, Pawcatuck. *Claimed per tablet;* Sodium bromid 5 grs. *Found;* Weights of 25 tablets ranged from 317.0 to 328.2, average, 324.2 mgms. They consisted wholly of sodium bromid and contained from 4.89 to 5.06, average, 5.00 grs. per tablet.

Tablets satisfactory.

Sodium Salicylate Tablets.

11450. *Sodium Salicylate Tablets*, made by Drug Products Co.; stock of Dr. C. P. Townsend, Bridgeport. *Claimed per tablet;* Sodium salicylate 5 grs. *Found;* Weights of 12 tablets ranged from 376.5 to 465.0, average, 412.6, mgms. They contained 71.55 per cent. sodium salicylate, or from 4.16 to 5.14, average, 4.56 grs. per tablet.

Tablets deficient in sodium salicylate, 5 of the 12 showing a deficiency greater than 10 per cent. and only one containing the full amount claimed; very variable in weight.

11569. *Sodium Salicylate Tablets*, made by the Maltbie Chemical Co.; stock of Dr. J. H. McLoughlin, Jewett City. *Claimed per tablet;* Sodium salicylate 5 grs. *Found;* Weights of 20 tablets ranged from 428.5 to 464.5, average, 451.0 mgms. They contained 70.71 per cent. sodium salicylate, or from 4.67 to 5.07, average, 4.92 grs. per tablet.

Tablets satisfactory.

11613. *Sodium Salicylate Tablets*, made by Yates Drug and Chemical Co.; stock of Dr. A. S. Brackett, Bristol. *Claimed per tablet;* Sodium salicylate 5 grs. *Found;* Weights of 21 tablets ranged from 425.0 to 450.5, average, 440.9, mgms. They contained 69.74 per cent. sodium salicylate, or from 4.57 to 4.85, average, 4.74 grs. per tablet.

Tablets passed.

Strontium Salicylate Tablets.

11580. *Strontium Salicylate Tablets*, made by Drug Products Co.; stock of Dr. N. B. Lewis, Norwich. *Claimed per tablet;*

Strontium salicylate, 5 grs. *Found;* Weights of 24 tablets ranged from 363.0 to 407.5, average, 386.5 mgms. They contained salicylic acid equivalent to 76.23 per cent. strontium salicylate (strontium present, but only 93.8 per cent. of theoretical amount), or from 4.27 to 4.80, average, 4.54 grs. per tablet.

Tablets deficient in strontium salicylate, 7 of the 24 showing a deficiency greater than 10 per cent., and no tablet containing the full amount claimed.

Strychnin Sulphate Tablets.

11564. *Strychnin Sulphate Tablets*, made by Bristol Myers Co.; stock of Dr. F. M. Dunn, New London. *Claimed per tablet;* Strychnin sulphate 1/60 gr. *Found;* Weights of 53 tablets ranged from 66.0 to 86.2, average, 75.2 mgms. They contained 1.31 per cent. strychnin sulphate, or from 0.0134 to 0.0174, average, 0.0152 gr. per tablet.

Tablets satisfactory.

11440. *Strychnin Sulphate Tablets*, made by Independent Pharmaceutical Co.; stock of Dr. C. K. Isham, Hartford. *Claimed per tablet;* Strychnin sulphate 1/60 gr. *Found;* Weights of 50 tablets ranged from 87.8 to 114.0, average, 96.0 mgms. They contained 1.09 per cent. strychnin sulphate, or from 0.0147 to 0.0192, average, 0.0161 gr. per tablet.

Tablets satisfactory.

11597. *Strychnin Sulphate Tablets*, made by Progressive Chemical Co., New Haven; stock of Dr. A. E. Abrams, Hartford. *Claimed per tablet;* Strychnin sulphate 1/50 gr. *Found;* Weights of 50 tablets ranged from 48.5 to 77.8, average, 67.6 mgms. They contained 0.79 per cent. strychnin sulphate, or from 0.0059 to 0.0095, average, 0.0082, gr. per tablet.

Tablets deficient in strychnin sulphate and very variable in weight.

11582. *Strychnin Sulphate Tablets*, made by the Tracy Co., New London; stock of Dr. T. Soltz, New London. *Claimed per tablet;* Strychnin sulphate 1/60 gr. *Found;* Weights of 48 tablets ranged from 96.1 to 123.2, average, 109.3 mgms. They contained 0.91 per cent. strychnin sulphate, or from 0.0135 to 0.0173, average, 0.0154 gr. per tablet.

Tablets satisfactory.

11594. *Strychnin Sulphate Tablets*, stock of Dr. W. Burke, Greenwich; **11604,** stock of Dr. C. A. Hamilton, Waterbury; both made by Yates Drug and Chemical Co. *Claimed per tablet;* Strychnin sulphate 1/60 gr. *Found;* In **11594** weights of 50 tablets ranged from 90.9 to 106.0, average, 99.0 mgms. They contained 1.03 per cent. strychnin sulphate, or from 0.0144 to 0.0169, average, 0.0158 gr. per tablet.

In **11604** weights of 51 tablets ranged from 94.0 to 101.0, average, 96.3 mgms. They contained 1.03 per cent. strychnin sulphate, or from 0.0149 to 0.0161, average, 0.0153 gr. per tablet.

Tablets in both samples satisfactory.

Solutions.

Elixir of Iron, Quinin and Strychnin.

11596. *Elixir of Iron, Quinin and Strychnin Phosphate*, made by Brewer and Co.; stock of Dr. A. E. Abrams, Hartford. *Claimed;* Each fl. dram contains tinct. iron citrochlorid 7½ min., quinin hydrochlorid ½ gr., strychnin phosphate 1/64 gr. *Found;* The elixir contained 16.68 per cent. alcohol by volume, 0.52 iron, 0.672 quinin (approximately) and 0.028 strychnin (approximately). It contained therefore, 8.8 min. tinct. iron citrochlorid, approximately 0.49 gr. quinin hydrochlorid and approximately 1/41 gr. strychnin phosphate.

Elixir satisfactory.

11616. *Elixir Iron, Quinin and Strychnin No.* 2, made by Yates Drug and Chemical Co.; stock of Dr. W. R. Tinker, South Manchester. *Claimed;* Each fl. oz. contains strychnin sulphate 2/15 gr., quinin sulphate 4 grs., tinct. iron citrochlorid 60 min., sodium citrate q.s., alcohol 19 per cent. *Found;* The elixir contained 17.55 per cent. alcohol by volume, 0.52 iron, 0.577 quinin (approximately), and 0.020 strychnin (approximately). It therefore contained per fl. oz. 70.9 min. tinct. iron citrochlorid, approximately 3.85 grs., quinin sulphate and approximately 2/15 gr. strychnin sulphate.

Elixir satisfactory.

Elixir Lactated Pepsin.

11617. *Elixir Lactated Pepsin Stronger*, made by the Harvey Co., stock of Dr. W. R. Tinker, South Manchester *Claimed;*

Each fl. dram contains pepsin (1/3000) 1 gr., pancreatin 1 gr., maltase ¼ gr., diastase 1/16 gr., lactic acid 5/32 min., hydrochloric acid ⅛ min., alcohol 17 per cent. *Found;* Spec. grav. @ 15.6° C. 1.1228, alcohol by volume 16.35 per cent.; pepsin and pancreatin present; diastatic action faint, if any. The pepsin present showed about 15.5 per cent. of the activity the claimed amount of U. S. P. pepsin should exhibit, the pancreatin from 8 to 10 per cent. of the claimed activity.

Elixir below the strength claimed.

Solution Iodin and Potassium Iodid.

11591. *Sol. Iodin and Potassium Iodid,* made by Yates Drug and Chemical Co.; stock of Dr. J. E. Black, Shelton. *Claimed;* Alcohol 91.5; tinct. iodin 1 part, alcohol 2 parts. *Found;* It contained 91.70 per cent. alcohol by volume, and 1.69 gms. potassium iodid and 2.83 gms. iodin per 100 cc. A solution of one part of tincture iodin U. S. P. and two parts of alcohol should contain from 1.50 to 1.83 gms. potassium iodid and from 2.16 to 2.50 gms. iodin per 100 cc.

Solution satisfactory.

Spt. Ammonia Aromatic.

11561. *Spt. Ammonia Aromatic,* made by Yates Drug and Chemical Co.; stock of Dr. C. W. Gaylord, Branford. *Claimed;* Spirit of Ammonia Aromatic, alcohol 67 per cent. *Found;* Sample contained 62.00 per cent. alcohol by volume, and 1.6167 gms. of ammonia per 100 cc. with aromatic oils.

Solution passed.

Syrup Hydriodic Acid.

11562. *Syrup Hydroidic Acid,* made by Norwich Pharmacal Co.; stock of Dr. C. W. Gaylord, Branford. *Claimed;* Syr. hydriodic acid, U. S. P. *Found;* Spec. grav. @ 25° C. 1.2155 1.32 gms. hydriodic acid per 100 cc.

Solution passed.

TABLE XIX.—VARIATIONS IN THE WEIGHTS OF MEDICINAL TABLETS.

Station No.	Name of Tablet.	Weight per tablet.			Maximum variation.		
		Maximum. mgms.	Minimum. mgms.	Average. mgms.	Above average. Per cent.	Below average. Per cent.	Total. Per cent.
	Acetasol.						
11592	Daggett & Miller Co.	363.4	345.9	353.2	2.9	2.1	5.0
	Ammon. Salicylate Compound.						
11588	Daggett & Miller Co.	454.8	405.2	425.5	6.9	4.8	11.7
	Antiseptic (Corrosive Sublimate).						
11577	Daggett & Miller Co. (7 grs.)	666.2	569.8	603.4	10.4	5.6	16.0
11619	Direct Sales Co. (7.3 grs.)	1016.8	970.8	983.9	3.3	1.3	4.6
11558	The Tracy Co. (7.3 grs.)	1083.9	1061.9	1073.3	1.0	1.1	2.1
	Alkaline Antiseptic.						
11625	National Drug Co.	883.1	834.2	863.2	2.3	3.4	5.7
	Antiseptic Germicide.						
11447	Maltbie Chem. Co.	1152.6	1040.8	1096.1	5.2	5.0	10.2
	Arsenious Iodid Comp.						
11445	Drug Products Co.	559.5	497.2	534.6	4.5	7.0	11.5
	Aspirin.						
11587	Daggett & Miller Co. (5 grs.)	447.0	422.5	434.1	3.0	2.7	5.7
11567	National Drug Co. (5 grs.)	356.0	339.0	347.1	2.6	2.3	4.9
	Aspirin Compound.						
11563	P. J. Noyes Co.	400.5	368.5	385.0	3.0	4.3	7.3
	Blaud's Compound.						
11572	Independent Pharm. Co.	646.2	577.8	613.3	5.4	5.8	11.2
11593	National Drug Co.	725.5	680.1	703.5	3.1	3.3	6.4
	Bronchitis No. 6.						
11585	C. Killgore	535.4	461.2	499.6	7.2	7.7	14.9
	Calcrease.						
11552	Maltbie Chem. Co.	621.4	570.0	590.9	5.2	3.5	8.7
	Calomel.						
11575	Buffington Pharm. Co. (1/10 gr.)	86.2	70.7	77.1	11.8	8.3	20.1
11573	Drug Products Co. (1/10 gr.)	89.4	72.7	76.7	16.6	5.2	21.8
11627	Harvey Co. (1 gr.)	126.8	111.5	119.9	5.8	7.0	12.8
11611	Moore & Co. (1/10 gr.)	38.4	28.2	36.2	6.1	22.1	28.2
11568	National Drug Co. (1/10 gr.)	87.2	73.6	79.3	10.0	7.2	17.2
11559	E. L. Patch Co. (1 gr.)	148.8	134.2	141.2	5.4	5.0	10.8
11609	Tailby-Nason Co. (2 grs.)	169.5	153.2	161.7	4.8	5.3	10.1
11586	Yates Drug & Chem. Co. (1/10 gr.)	98.5	84.5	94.9	3.8	11.0	14.8
11603	" " " " (1/10 gr.)	110.9	90.1	106.3	4.3	15.2	19.5
11557	" " " " (1/10 gr.)	99.6	90.0	95.8	4.0	6.1	10.1
11595	" " " " (¼ gr.)	100.9	90.1	96.8	4.2	6.9	11.1
11614	" " " " (¼ gr.)	95.5	86.2	91.1	4.8	5.4	10.2
	Calomel & Soda.						
11571	Independent Pharm. Co. (¼ gr.)	130.2	116.5	124.3	4.7	6.3	11.0
11570	E. L. Patch Co. (½ gr.)	166.9	150.0	160.3	4.1	6.4	10.5
1606	Yates Drug & Chem. Co. (1/10 gr.)	129.6	121.9	126.5	2.5	3.6	6.1
	Cascara Compound.						
7	E. L. Patch Co.	199.6	165.9	181.5	10.0	8.6	18.6
	Cathartic Compound.						
	aggett & Miller Co.	443.9	410.2	430.3	3.2	4.7	7.9
Co.	ional Drug Co.	346.1	320.0	332.0	4.2	3.6	7.8

TABLE XIX.—VARIATIONS IN THE WEIGHTS OF MEDICINAL TABLETS—*Continued.*

Station No.	Name of Tablet.	Weight per tablet.			Maximum variation.		
		Maximum. mgms.	Minimum. mgms.	Average. mgms.	Above average. Per cent.	Below average. Per cent.	Total. Per cent.
	Cold Tablets.						
1576	Buffington Pharm. Co.	269.6	252.8	263.1	2.5	3.9	6.4
1618	Moore & Co.	462.2	415.4	446.4	3.5	7.0	10.5
	Hammond's Tonic.						
1560	E. L. Patch Co.	100.8	95.8	98.9	1.9	3.1	5.0
	Headache Tablets (Acetanilid).						
1608	Brewer & Co. (3.5 grs.)	477.8	452.7	462.3	3.4	2.1	5.5
1626	National Drug Co. (3.5 grs.)	403.9	375.9	389.2	3.9	3.4	7.3
1444	" " " (3 grs.)	459.8	438.5	446.1	3.4	1.7	4.8
1622	E. L. Patch Co. (2 grs.)	254.4	227.2	240.3	5.9	5.5	11.4
1620	Surg. & Phys. Supply Co. (2 grs.)	349.8	298.7	328.8	6.4	9.2	15.6
1583	Tailby-Nason Co. (2 grs.)	233.4	198.4	223.0	4.7	11.0	15.7
1601	" " " (2 grs.)	230.6	202.6	221.2	4.2	8.4	12.6
1605	Yates Drug & Chem. Co. (2.5 grs.)	362.7	341.6	350.6	3.2	2.6	5.8
	Hexamethylene tetramine.						
1598	Daggett & Miller Co. (5 grs.)	706.7	676.9	694.7	1.7	2.6	4.3
1612	Yates Drug & Chem. Co. (5 grs.)	338.2	311.8	323.6	4.5	3.6	8.1
	Hypophosphites Compound.						
1599	Daggett & Miller Co.	177.9	150.2	161.4	10.2	6.9	17.1
	Iodized Calcium.						
1449	Daggett & Miller Co. (1 gr.)	111.0	91.5	101.7	9.1	10.0	19.1
	LaGrippe Tablets.						
1624	Harvey Co.	405.9	350.2	380.4	6.7	7.9	14.6
	Mercury Protoiodid.						
1602	Polk Calder Co. (¼ gr.)	102.5	97.0	99.1	3.4	2.1	5.5
	Myalgie.						
1566	Daggett & Miller Co.	419.4	383.2	406.6	3.1	5.8	8.9
	Neuralgie.						
1610	Yates Drug & Chem. Co.	324.2	309.5	317.9	2.0	2.6	4.6
	Phenolphthalein.						
1581	G. F. Harvey Co. (2 grs.)	303.9	276.9	287.2	5.8	3.6	9.4
1589	" " " (2 grs.)	305.2	288.7	297.3	2.7	2.9	5.6
	Phenolphthalein & Calomel.						
1621	Tailby-Nason Co. (1/10 gr.)	109.2	90.9	102.5	6.5	11.3	17.8
	Quinin sulphate.						
1615	Tailby-Nason Co. (2 grs.)	336.9	312.0	322.6	4.4	3.3	7.7
1623	John Wyeth & Bro. (2 grs.)	280.0	256.5	266.3	5.1	3.7	8.8
1590	Yates Drug & Chem. Co. (grs. 2)	234.5	210.0	225.3	4.1	6.8	10.9
	Quinin & Nux vomica.						
1600	Tailby-Nason Co.	195.3	175.9	186.1	4.9	5.5	10.4
	Sodium bromid.						
1574	Buffington Pharm. Co. (5 grs.)	328.2	317.0	324.2	1.2	2.2	3.4
	Sodium salicylate.						
1450	Drug Products Co. (5 grs.)	465.0	376.5	412.6	12.7	8.7	21.4
1569	Maltbie Chem. Co. (5 grs.)	464.5	428.5	451.0	3.0	5.0	8.0
1613	Yates Chem. & Drug Co. (5 grs.)	450.5	425.0	440.9	2.2	3.6	5.8
	Strontium salicylate.						
1580	Drug Products Co. (5 grs.)	407.5	363.0	386.5	5.4	6.1	11.5

TABLE XIX.—VARIATIONS IN THE WEIGHTS OF MEDICINAL TABLETS—*Concluded.*

Station No.	Name of Tablet.	Weight per tablet.			Maximum variation.		
		Maximum. mgms.	Minimum. mgms.	Average. mgms.	Above average. Per cent.	Below average. Per cent.	Total. Per cent.
	Strychnin sulphate.						
11564	Bristol Myers Co. (1/60 gr.)........	86.2	66.0	75.2	14.6	12.2	26.8
11440	Independent Pharm. Co. (1/60 gr.)..	114.0	87.8	96.0	18.8	8.5	27.1
11597	Progerssive Chem. Co. (1/50 gr.)...	77.8	48.5	67.6	15.1	28.3	43.4
11582	The Tracy Co. (1/60 gr.)..........	123.2	96.1	109.3	12.7	12.1	24.8
11594	Yates Drug & Chem. Co. (1/60 gr.)	106.0	90.9	99.0	7.1	8.2	15.3
11604	" " " " (1/60 gr.)	101.0	94.0	96.3	4.9	2.4	7.3

Summary.

Fifteen of the 76 samples did not contain the amounts of drugs claimed, allowing a tolerance of 10 per cent. The names of these with their manufacturers were as follows:

Buffington Pharm. Co.
  Cold Tablets.
Daggett and Miller Co.
  Acetasol.
  Ammonium Salicylate Comp.
  Antiseptic Tablets No. 2.
  Aspirin Tablets.
  Tabs. Hypophosphites Comp.
  Myalgie (Dr. Harvey).
Drug Products Co.
  Sodium Salicylate.
  Strontium Salicylate.
The Harvey Co.
  Elixir Lactated Pepsin.
National Drug Co.
  Cathartic Compound.
B. F. Noyes Co.
  Aspirin Compound.
Progessive Chemical Co.
  Strychnin Sulphate.
Tailby-Nason Co.
  Calomel Tablets.
John Wyeth and Bro.
  Quinin Sulphate.

Or to summarize the whole inspection, of 111 samples of tablets 22 were deficient, and of 18 samples of solutions 8 were unsatisfactory.

Variations in the Weights of Tablets.

This subject having been discussed at some length in our Report for 1916, only a summary of the results will be discussed here. We now have data on the variations in weight of 111 samples of tablets. While in some cases these are remarkably uniform in weight, in others the variations are so great as to indicate very careless manufacture. Table XIX gives the detailed results on this year's samples.

TABLE XX.—VARIATIONS IN MEDICAMENT IN TABLETS.

Station No.	Name of Tablet.	Amount declared. grs.	Amount found. Maximum. grs.	Minimum. grs.	Average. grs.	Maximum Variation from Claim. Above.	Below.
						%	%
11588	Ammonium Salicylate Comp.						
	Ammonium salicylate.....	2	1.90	1.70	1.78	0	15.0
	Caffein..................	1	0.94	0.84	0.88	0	16.0
	Acetanilid...............	1⅛	1.35	1.21	1.26	1.5	9.0
11577	Antiseptic Tablets No. 2.						
	Corrosive sublimate.......	7	5.78	4.94	5.24	0	29.4
11619	Antiseptic Tablets No. 1.						
	Corrosive sublimate.......	7.3	7.41	7.08	7.17	1.1	3.0
11558	Antiseptic Tablets No. 1.						
	Corrosive sublimate.......	7.3	7.79	7.63	7.72	6.7	4.1
11447	Antiseptic Germicide.						
	Mercuric iodid...........	⅜	0.361	0.326	0.343	0	13.1
	Potassium iodid..........	⅜	0.512	0.463	0.487	36.5	0
	Sodium bicarbonate.......	6	16.88	15.14	15.94		
11445	Arsenious Iodid Compound.						
	Potassium iodid..........	2	1.91	1.70	1.82	0	15.0
11587	Aspirin.						
	Aspirin..................	5	3.70	3.50	3.59	0	30.0
11567	Aspirin.						
	Aspirin..................	5	4.66	4.44	4.55	0	11.2
11563	Aspirin Compound.						
	Aspirin..................	1¼	1.15	1.05	1.10	0	16.0
	Strontium salicylate......	2	1.90	1.75	1.83	0	12.5
	Acetphenetidin...........	1	0.87	0.80	0.84	0	20.0
	Caffein..................	¼	0.235	0.216	0.226	0	13.6
11572	Blaud's Compound.						
	Ferrous carbonate........	1	1.54	1.38	1.46	54.0	0
	Arsenious acid...........	1/60	0.0160	0.0143	0.0151	0	14.4
	Strychnin sulphate.......	1/60	0.0189*	0.0169*	0.0180*	13.2*	0*
11593	Blaud's Compound.						
	Ferrous carbonate........	1	0.93	0.87	0.90	0	13.0
	Arsenious acid...........	1/60	0.0168	0.0157	0.0163	0.6	6.0
	Manganese binoxid.......	1	0.98	0.92	0.95	0	8.0
11585	Bronchitis No. 6.						
	Strychnin sulphate.......	1/60	0.0190	0.0164	0.0177	13.8	1.8
	Terpen hydrate...........	2	1.87*	1.61*	1.74*	0*	19.5*
11575	Calomel Tablet Triturates.						
	Calomel.................	1/10	0.109	0.089	0.097	9.0	11.0
11573	Calomel Tablets.						
	Calomel..................	1/10	0.116	0.094	0.099	16.0	6.0
11627	Calomel Tablet Triturates.						
	Calomel.................	1	0.97	0.85	0.91	0	15.0
11611	Calomel Tablets.						
	Calomel.................	1/10	0.109	0.068	0.094	9.0	32.0
11568	Calomel Tablet Triturates.						
	Calomel.................	1/10	0.107	0.091	0.097	7.0	9.0

* Approximate.

TABLE XX.—VARIATIONS IN MEDICAMENT IN TABLETS—*Continued.*

Station No.	Name of Tablet.	Amount declared. grs.	Amount found.			Maximum Variation from Claim.	
			Maximum. grs.	Minimum. grs.	Average. grs.	Above.	Below.
11559	Calomel Tablet Triturates.					%	%
	Calomel.................	1	1.04	0.94	0.99	4.0	6.0
11609	Calomel Tablets.						
	Calomel.................	2	1.82	1.64	1.73	0	18.0
11586	Calomel Tablets.						
	Calomel.................	1/10	0.101	0.086	0.097	1.0	14.0
11603	Calomel Tablets.						
	Calomel.................	1/10	0.108	0.088	0.103	8.0	12.0
11557	Calomel Tablets.						
	Calomel.................	1/10	0.108	0.098	0.104	8.0	2.0
11595	Calomel Tablets.						
	Calomel.................	¼	0.253	0.226	0.242	1.2	9.6
11614	Calomel Tablets.						
	Calomel.................	¼	0.252	0.228	0.242	0.8	8.8
11571	Calomel and Soda Tablets No. 3.						
	Calomel.................	¼	0.252	0.225	0.240	0.8	10.0
	Sodium bicarbonate.......	1	1.15	1.03	1.10	15.0	0
11570	Calomel Compound, Tablets No. 6.						
	Calomel.................	½	0.509	0.456	0.488	1.8	8.8
	Sodium bicarbonate.......	½(?)	1.93	1.73	1.85	(?)	(?)
11606	Calomel and Soda Tablets.						
	Calomel.................	1/10	0.107	0.100	0.104	7.0	0
	Sodium bicarbonate.......	1	1.02	0.96	1.00	2.0	4.0
11578	Cathartic Compound.						
	Calomel.................	1	1.00	0.92	0.97	0	8.0
11452	Cathartic Compound.						
	Calomel.................	1	0.78	0.72	0.75	0	28.0
11576	Cold Tablets.						
	Acetanilid...............	1½	1.39	1.30	1.36	0	13.3
	Caffein citrated..........	½	0.51	0.47	0.49	2.0	6.0
11618	Cold Tablets No. 2.						
	Quinin sulphate..........	2	2.05	1.84	1.98	2.5	8.0
11608	Acetanilid Compound Tablets						
	Acetanilid...............	3½	3.50	3.32	3.39	0	5.1
	Caffein..................	½	0.50	0.48	0.49	0	4.0
	Sodium bicarbonate.......	1	1.03	0.97	0.99	3.0	3.0
11626	Acetanilid Compound Tablets No. 4.						
	Acetanilid...............	3½	3.61	3.36	3.48	3.1	4.0
	Sodium bicarbonate.......	8/10	0.96	0.90	0.93	20.0	0
	Sodium bromid...........	1/10	0.091	0.085	0.088	0	15.0
	Caffein citrated..........	½	0.51	0.48	0.50	2.0	4.0
11444	Acetanilid Compound Tablets No. 17.						
	Acetanilid...............	3	3.06	2.92	2.97	2.0	2.7
	Caffein citrated..........	½	0.51	0.49	0.50	2.0	2.0
	Sodium bicarbonate.......	2	2.02	1.93	1.96	1.0	3.5

TABLE XX.—VARIATIONS IN MEDICAMENT IN TABLETS—*Continued.*

Station No.	Name of Tablet.	Amount declared. grs.	Amount found. Maximum. grs.	Minimum. grs.	Average. grs.	Maximum Variation from Claim. Above.	Below.
1622	Migrain Tablets No. 2.					%	%
	Acetanilid	2	2.13	1.90	2.01	6.5	5.0
	Caffein citrated	½	0.52	0.47	0.49	4.0	6.0
1620	Migrain Tablets No. 3.						
	Acetanilid	2	1.95	1.77	1.84	0	11.5
	Caffein citrated	½	0.48	0.41	0.45	0	18.0
1583	Migrain Tablets.						
	Acetanilid	2	2.09	1.78	2.00	4.5	11.0
	Caffein citrated	½	0.52	0.44	0.50	4.0	12.0
1601	Migrain Tablets.						
	Acetanilid	2	2.06	1.81	1.98	3.0	9.5
	Caffein	¼	0.26	0.22	0.24	4.0	12.0
1605	Headache Tablets (Hawley).						
	Acetanilid	2½	2.61	2.46	2.52	4.4	1.6
	Caffein	½	0.50	0.47	0.48	0	6.0
	Sodium bicarbonate	1	1.07	1.01	1.04	7.0	0
1598	Hex-uro-gen.						
	Hexamethylene tetramin	5	5.65	5.41	5.55	13.0	0
	Acid sodium phosphate	5	4.60	4.41	4.52	0	11.8
1612	Hexaform Tablets.						
	Hexamethylene tetramine	5	5.21	4.80	4.98	4.2	4.0
1624	La Grippe Tablets.						
	Acetanilid	1¾	1.95	1.68	1.83	11.4	4.0
	Caffein citrated	½	0.56	0.48	0.53	12.0	4.0
1602	Mercury Protoiodid Tablets.						
	Mercury protoiodid	¼	0.240	0.228	0.233	0	8.8
1566	Myalgie (Dr. Harvey).						
	Sodium salicylate	2	1.38	1.26	1.33	0	37.0
	Acetanilid	2	1.64	1.50	1.59	0	25.0
	Caffein citrated	½	0.32	0.29	0.31	0	42.0
	Cerium oxalate	½	0.46	0.42	0.45	0	16.0
1610	Neuralgie Tablets No. 5.						
	Acetanilid	2	1.98	1.89	1.94	0	5.5
1581	Phenolphthalein Tablets.						
	Phenolphthalein	2	2.27	2.07	2.15	13.5	0
1589	Phenolphthalein Tablets.						
	Phenolphthalein	2	2.03	1.92	1.98	1.5	4.0
1621	Phenolphthalein and Calomel Tablets.						
	Phenolphthalein	1/10	0.117	0.097	0.110	17.0	3.0
	Calomel	1/10	0.111	0.092	0.104	11.0	8.0
1615	Quinin Sulphate Tablets.						
	Quinin sulphate	2	2.00	1.85	1.91	0	7.5
1623	Quinin Sulphate Tablets.						
	Quinin sulphate	2	1.90	1.74	1.81	0	13.0
1590	Quinin Sulphate Tablets.						
	Quinin sulphate	2	2.25	2.01	2.16	12.5	0
1600	Quinin and Nux Vomica.						
	Quinin	1	0.99	0.89	0.94	0	11.0

TABLE XX.—VARIATIONS IN MEDICAMENT IN TABLETS—*Concluded.*

Station No.	Name of Tablet.	Amount declared. grs.	Amount found.			Maximum Variation from Claim.	
			Maximum. grs.	Minimum. grs.	Average. grs.	Above.	Below.
						%	%
11574	Sodium Bromid Tablets. Sodium bromid	5	5.06	4.89	5.00	1.2	2.2
11450	Sodium Salicylate Tablets. Sodium salicylate	5	5.14	4.16	4.56	2.8	16.8
11569	Sodium Salicylate Tablets. Sodium salicylate	5	5.07	4.67	4.92	1.4	6.6
11613	Sodium Salicylate Tablets. Sodium salicylate	5	4.85	4.57	4.74	0	8.6
11580	Strontium Salicylate Tablets. Strontium salicylate	5	4.80	4.27	4.54	0	14.6
11564	Strychnin Sulphate Tablets. Strychnin sulphate	1/60	0.0174	0.0134	0.0152	4.2	19.8
11440	Strychnin Sulphate Tablets. Strychnin sulphate	1/60	0.0192	0.0147	0.0161	15.0	12.0
11597	Strychnin Sulphate Tablets. Strychnin sulphate	1/50	0.0095	0.0059	0.0082	0	70.5
11582	Strychnin Sulphate Tablets. Strychnin sulphate	1/60	0.0173	0.0135	0.0154	3.6	19.2
11594	Strychnin Sulphate Tablets. Strychnin sulphate	1/60	0.0169	0.0144	0.0158	1.2	13.8
11604	Strychnin Sulphate Tablets. Strychnin sulphate	1/60	0.0161	0.0149	0.0153	0	10.8

Below is shown a comparison of between Kebler's results in 1914 with 231 lots and our own with 111 samples.

	Kebler. Per cent.	Connecticut. Per cent.
Showing variation less than 10%	43	44
" " more " 10%	57	56
" " " " 12%	44	35
" " " " 15%	28	26
" " " " 20%	9	10

The results of the two inspections are strikingly similar.

Twelve of our samples show total variations in weight of 20 per cent. or over. The fact that eight of these contained such potent drugs as corrosive sublimate, acetphenetidin, nitroglycerin and strychnin sulphate, makes the discrepancy a matter of considerable gravity.

Variations in Amount of Medicament in Tablets.

It is of even greater importance, however, to ascertain how closely the composition of the tablets conforms with that claimed

for them on the label. In securing these data it has been necessary to assume that the tablets are of uniform composition, and that the manufacturer has carefully prepared his mix before passing it through the machines. The small quantity of medicament in certain tablets makes the analysis of individual tablets of such drugs almost an impossibility. In the table which follows, therefore, it has been assumed that all the tablets in any one sample were chemically the same and the amounts of medicament recorded for the heaviest and lightest tablets have been calculated from the analysis of a composite of 10, 25 or more tablets. Table XX gives the detailed results in this respect on this year's samples.

Considering the variations both above and below the claimed amounts, we find a wide range, from 54.0 per cent. above to 70.5 per cent. below. The following is a summary of these variations in both directions in the 111 samples:

	Number.	Per cent. of total determinations.
Variations less than 5%..........	169	55
" from 5.00–9.99%.....	56	18
" " 10.00–14.99%...	40	13
" " 15.00–19.99%...	22	7
" " 20.00–29.99%...	10	3
" " 30.00–50.00%...	8	3
" over 50%.............	4	1

That is, 27 per cent. of all the drugs determined varied from the claimed amount by more than 10 per cent. and 14 per cent. by more than 15 per cent.

In the smaller tablets a slight variation causes a relatively large percentage variation, and possibly a comparison based on grains of active drug present is more illuminating. On this basis the following variations from claim are shown:

	Claimed. grs.	Found. Max. grs.	Found. Min. grs.	Maximum Variation from Claim. grs.	Maximum Variation from Claim. Per cent.
Acetanilid.............	1.33	1.35	1.21	—0.12	— 9.0
"	1.50	1.30	1.30	—0.20	—13.3
"	1.75	1.95	1.68	+0.20	+11.4
"	2.00	2.13	1.50	—0.50	—25.0
"	2.50	2.61	2.46	+0.11	+4.4
"	3.00	3.06	2.92	—0.08	— 2.7
"	3.50	3.61	3.32	—0.18	— 5.1
Acetphenetidin..........	1.00	0.87	0.80	—0.20	—20.0
Ammonium salicylate....	2.00	1.90	1.70	—0.30	—15.0

	Claimed. grs.	Found. Max. grs.	Found. Min. grs.	Maximum Variation from Claim. grs.	Maximum Variation from Claim. Per cent
Arsenious oxid..........	0.0167	0.0168	0.0143	—0.0024	—14.4
Aspirin................	1.25	1.15	1.05	—0.20	—16.0
"	5.00	4.66	3.50	—1.50	—30.0
Caffein.................	0.25	0.260	0.216	—0.034	—13.6
"	0.50	0.50	0.47	—0.03	— 6.0
"	1.00	0.94	0.84	—0.16	—16.0
Caffein citrated.........	0.50	0.56	0.29	—0.21	—42.0
Calomel................	0.10	0.116	0.068	—0.032	—32.0
"	0.25	0.253	0.225	—0.025	—10.0
"	0.50	0.509	0.456	—0.044	— 8.8
"	1.00	1.04	0.72	—0.28	—28.0
"	2.00	1.82	1.64	—0.36	—18.0
Cerium oxalate.........	0.50	0.46	0.42	—0.08	—16.0
Corrosive sublimate.....	7.00	5.78	4.94	—2.06	—29.4
" "	7.30	7.79	7.08	+0.49	+6.7
Ferrous carbonate.......	1.00	1.54	0.87	+0.54	+54.0
Hexamethylene tetramine	5.00	5.65	4.80	+0.65	+13.0
Manganese binoxid......	1.00	0.98	0.92	—0.08	— 8.0
Mercury iodid..........	0.375	0.361	0.326	—0.049	—13.1
Mercury protoiodid......	0.25	0.240	0.228	—0.022	— 8.8
Phenolphthalein.........	0.10	0.117	0.097	+0.017	+17.0
"	2.00	2.27	1.92	+0.27	+13.5
Potassium iodid.........	2.00	1.91	1.70	—0.30	—15.0
Quinin sulphate*........	1.00	0.99	0.89	—0.11	—11.0
" "	2.00	2.25	1.74	—0.26	—13.0
Sodium bicarbonate.....	0.80	0.96	0.90	+0.16	+20.0
" "	1.00	1.15	0.96	+0.15	+15.0
" "	2.00	2.02	1.93	—0.07	— 3.5
Sodium bromid.........	0.10	0.091	0.084	—0.015	—15.0
" "	5.00	5.06	4.89	—0.11	— 2.2
Sodium phosphate, acid..	5.00	4.60	4.41	—0.59	—11.8
Sodium salicylate.......	2.00	1.38	1.26	—0.74	—37.0
" "	5.00	5.14	4.16	—0.84	—16.8
Strontium salicylate.....	2.00	1.90	1.75	—0.25	—12.5
" "	5.00	4.80	4.27	—0.73	—14.6
Strychnin sulphate......	0.0167	0.0192	0.0134	—0.0033	—19.8
" "	0.0200	0.0095	0.0059	—0.0141	—70.5
Terpen hydrate.........	2.00	1.87	1.61	—0.39	—19.5

While the composition of the tablets agrees as a rule very satisfactorily with that claimed, the above table shows that the individual variations are far too wide. Moreover, the maximum variation is more often below than above the amount claimed, only 9 of the 47 drugs determined showing a maximum above the claim.

These variations for the whole 111 samples of tablets may be summarized as follows:

	Number.	Per cent.
Variation less than 5%	11	13
" " " 10%	30	37
" " " 15%	47	57
" " " 20%	62	75
" " " 30%	73	89
" " " 50%	78	95
" more " 50%	4	5

In other words, in more than one-third of the determinations the variation from the claim amounts to over 10 per cent. in more than one-half to over 15 per cent., in one-fourth to over 25 per cent., while in 4 drugs the maximum variation amounts to from 54 to 70.5 per cent.

Judging by examinations made by Kebler and by ourselves in past years, tablets taken from the stocks of druggists show quite as great variations as these. It is the tablets themselves we criticize, not the persons who happen to sell or dispense them.

TOILET PREPARATIONS.

At the last session of the Legislature an act was passed forbidding the use of wood alcohol in any preparation intended for internal or external use; and if used in products intended for technical purposes a poison label on the container is required.

To test the observance of this law the Dairy Commissioner submitted 25 samples of toilet preparations taken from the stock of dealers in barbers' supplies. The results of our examination of these are given in Table XXI.

Twelve of the 25 samples contained wood alcohol in amounts ranging from about 11 per cent to 84.80 per cent. Not only was this use of wood alcohol illegal, but in no instance was its presence in these samples stated on the label. Sample **12216**, although claiming 90 per cent. methyl alcohol, contained only 39.20 per cent. alcohol all in the form of ethyl. Sample **12209** claimed "menthol" alcohol, whatever that is, and contained 39.56 per cent. methyl alcohol. Five samples claimed to be bay rum, which if of standard quality should contain about 58 per cent. of grain alcohol; they actually contained 30.64 per cent. alcohol (28 per cent. of which was methyl), 15.00 per cent. grain alcohol (30 per cent. claimed),

TABLE XXI.—TOILET PREPARATIONS.

Sample No.	Dealer.	Brand.	Specific gravity @ 15.6° C.	Total alcohol by vol.	Per cent. of total alcohol in form of methyl.
12205	A. Amico, Seymour	Imported Bay Rum (C. A. Johnson, New Haven)	0.9536	39.64	28.83
12206	" " "	Bayryber Toilet Water (F. J. Mangini, Waterbury)	0.9496	40.60	100.00
12214	T. Baker, Danbury	Unexcelled Herb Rub (Rich. Lenroth, Jersey City)	0.9778	21.96	0
12215	Frank Dieli, Bridgeport	Bouquet de Fleurs	0.9974	3.00	0
12216	" " "	Circassian Hair Dressing	0.9610	39.20[1]	0
12217	" " "	Domestic Bay Rum	0.9811	15.00[2]	0
12223	Jos. Fanighetti, Waterbury	Extr. Witch Hazel (C. A. Johnson, New Haven)	0.9877	8.90	0
12207	C. A. Johnson, New Haven	Imported Bay Rum	0.9536	40.32	27.80
12208	" " " " "	Letonheaux Eau de Quinine	0.9193	59.60[3]	0
12209	" " " " "	Bouquet Toilet Water	0.9530	39.56[4]	100.00
12219	G. Lupo, New Haven	Bay Toilet Water	0.9656	27.52	100.00
12220	" " " "	Superior Hair Tonic	0.9562	36.92	100.00
12224	F. J. Mangini, Waterbury	Hoffmann's Hair Tonic	0.9477	43.12	0
12210	A. Palmer, Bridgeport	Quinine Tonic Comp. (Rich. Lenroth, Jersey City)	0.9599	37.56	0
12211	" " "	Glacier Scalp Rub (Rich. Lenroth, Jersey City)	0.9367	48.24	0
12200	N. Seidman, Hartford	Eau de Quinine	0.9678	29.64[5]	47.67
12201	" " "	Sage Head Rub	0.9611	34.20[6]	0
12202	" " "	Floral Bouquet Toilet Water	0.9555	37.92[7]	0
12218	E. F. Stefhan, New Haven	Violet Toilet Water	0.9674	28.36	0
12222	R. F. Surinek, Bridgeport	Remo Bay Rum (Remo Co., Bridgeport)	0.8730	84.80	100.00
12221	" " " "	Remo Quinine Hair Tonic (Remo Co., Bridgeport)	0.9101	70.60	100.00
12212	J. Tavano, Bridgeport	Carnation Hair Dressing (Barber Supplies Co., Bridgeport)	0.9631	29.00	100.00
12213	" " "	Comtesse Aime Bay Rum (Perfumerie Comtesse Aime Paris)	0.9726	23.24[8]	0
12203	E. Warshaw & Co., Bridgeport	Carnation Hair Tonic	0.9636	30.00	100.00
12204	" " " " "	Eau de Quinine Hair Tonic	0.9375	51.32	100.00

[1] Claimed 90% ethyl alcohol.
[2] Claimed 30% grain alcohol.
[3] Claimed 62% alcohol.
[4] Claimed 50% menthol alcohol.
[5] Claimed 50% grain alcohol.
[6] Claimed 45% grain alcohol.
[7] Claimed 40% grain alcohol.
[8] Claimed 25% grain alcohol.

40.32 per cent. (all methyl), 84.80 per cent. ethyl, and 23.24 per cent. ethyl (25 per cent. claimed). Similarly the one sample of extract of witch hazel; which should contain at least 14.25 per cent. of grain alcohol, contained only 8.90 per cent.

The following is a summary of the examination:

Containing wood alcohol:

12205 Johnson's Imported Bay Rum.
12207 " " "
12209 " Bouquet Toilet Water.
12206 Mangini's Bayryber Toilet Water.
12219 Lupo's Bay Toilet Water.
12220 " Superior Hair Tonic.
12200 Seidman's Eau de Quinine.
12222 Remo Bay Rum.
12221 " Quinine Hair Tonic.
12212 Carnation Hair Dressing.
12203 Carnation Hair Tonic.
12294 Warshaw's Eau de Quinine Hair Tonic.

Containing less grain alcohol than standard:

12223 Johnson's Extr. Witch Hazel.

Containing less alcohol than claimed:

12216 Dieli's Circassian Hair Dressing.
12217 " Domestic Bay Rum.
12208 Johnson's Letonneaux Eau de Quinine.
12209 " Bouquet Toilet Water.
12200 Seidman's Eau de Quinine.
12201 " Sage Head Rub.
12202 " Floral Bouquet Toilet Water.
12213 Comtesse Aime Bay Rum.

MISCELLANEOUS DRUGS.

11324. *Watkins Cough Medicine,* The J. R. Watkins Medicine Co., Winona, Minn. "Alcohol 11 per cent., chloroform 4 min. per oz."

Spec. grav. @15.6° C.	1.2352
Alcohol by volume	12.73
Solids	59.08
Ash	0.30
Chloroform	0.67
Sugar	present
Alkaloids	present
Gelsemium	indicated
Saccharin	present
Morphin, opium, cocain	absent

This is a sugar syrup containing alcohol, chloroform, saccaharin and gelsemium.

11325. *Watkins Catarrh Relief*, The J. R. Watkins Medicine Co., Winona, Minn. "2.5 grs. chloterone per av. oz."

Loss — 100°C.	3.43
Chloretone	0.45
Volatile oils, menthol	present
Alkaloids	absent

The above medicine was tested chiefly for the chloretone. The base was a mixture of a non-saponifiable hydrocarbon and a fat.

12225. *Hanford's Balsam of Myrrh*, G. C. Hanford Mfg. Co. "Wood alcohol 84%." This was tested only for methyl (wood) alcohol, of which it contained 88.96 per cent. by volume. Its sale is illegal in this state.

12226. *Elastic Soluble Gelatine Capsules No.* 49 *Santal Oil*, 10 *minims*, American Druggists Syndicate, Long Island City, N. Y. Cost $3.25 per 100 capsules. The capsules contained on the average 8.65 minims of santal oil. The oil showed a specific gravity @ 25° C. of 0.9726, an optical rotation of —15.7 @ 20° C. in a 100 mm tube, and contained 95.90 per cent. of total alcohols calculated as santalol.

5583. *Koch's Celebrated Hair Dye.* Sample consisted of two bottles. Bottle 1 contained a clear, yellow liquid which darkened on exposure to the air; it consisted of a solution of pyrogallol in water (2.858 gms. per 100 cc.). Bottle 2 contained a clear liquid with an ammoniacal odor. It consisted of an ammoniacal solution of silver nitrate (0.771 gm. of silver nitrate and 5.75 gms. of ammonia per 100 cc.).

12150. *Silicate of Soda*, dist. by The Talcott Co., Hartford. It contained 28.44 per cent. silicic oxid and 0.04 per cent. suspended matter; sodium was present, and a very slight amount of iron and alumina. **11744.** *Turpentine*, General Naval Stores Co., New York. It had a specific gravity @ 15.6° of 0.8605 and a refractive index @ 20° C. of 1.4685; it had an initial distillation temperature of about 150° and about 93 per cent. distilled under 170°; unpolymerized residue 3.2 per cent. Sample passed.

MISCELLANEOUS SAMPLES SENT BY PRIVATE INDIVIDUALS.

Anzac. A sample of this temperance beer contained 0.25 per cent of alcohol by volume.

Butter. Thirteen samples were tested, of which 8 were genuine, 2 were oleomargarine, 2 were renovated butter, and one contained the excessive moisture of 38.3 per cent.

Butter Color. The sample examined was annatto in oil solution.

Coffee. The single sample tested showed no adulteration.

Coffee Wax. A substance obtained during the refining process for caffein contained water 6.27, ash 2.10, protein (N x 6.25) 19.00, ether extract 71.31, and nitrogen-free extract 1.32 per cent.

Coffee Residue. A residue from the manufacture of Kaffee Hag. The coffee is dry charred before treatment with the solvent, and the solution containing the caffein is filtered this residue being left. It contained

Water	8.57	Nitrogen-free extract	52.11
Ash	10.79	Total nitrogen	1.90
Protein (N x 6.25)	11.88	Total phosphoric acid	0.24
Ether extract	0.25	Potash, water-soluble	4.10
Fiber	16.40		

Confectionery. A sample of *Lolly Pops* suspected of having cuased sickness was examined. No heavy metals or alkaloids were found; the color was a mixture of caramel and a small amount of Orange I.

Cottage Cheese. Old Fashioned Cottage Cheese, made by Benvenuto Farm, West Bloomfield. It contained.

Water	26.28	Ash	1.57
Solids	23.72	Lactic acid	0.76
Protein	17.61	Lactose, etc.	1.38
Fat	2.40		

Cream Nine samples were tested containing from 17 to 39 per cent. of butter fat; two of these contained sucrate of lime.

Fish. Two samples were tested for preservatives with negative results.

Flour. The sample tested was not adulterated.

Grape Juice. A sample suspected of containing poison was found normal in all respects.

Ice Cream. The three samples tested contained from 10.27 to 11.92 per cent. of butter fat.

Maple Syrup. The sample tested contained 66.70 per cent. solids, 0.69 ash and had a Winton lead number of 1.36 (2.04 on dry basis).

Milk. Twenty-four samples were tested, of which 10 were genuine, 12 were below standard, 1 was watered and 1 was both skimmed and watered.

Olive Oil. The sample examined was very largely, if not entirely, peanut oil.

Peanut Butter. A sample sold by the Great Atlantic and Pacific Tea Co. contained the following:

Water	1.93	Fat	45.97
Ash	2.99	Fiber	1.59
Protein (N x 6.25)	28.13	Nitrogen-free extract	19.[illegible]9

Salt Pork. A sample of the brine and one of the meat itself, each contained boric acid and nitrates.

Semolina. Sample of two cars sold by L. A. Viviano, New York, were analyzed with the following results:

	1st car.	2nd car.
Water	12.53	13.23
Ash	0.70	0.65
Protein (N x 6.25)	13.13	12.63
Fiber	0.27	0.24
Fat	1.14	1.07
Nitrogen-free extract	72.23	72.18

Sludge from Gas Co. The sample contained water 65.00, ash 29.04, organic and volatile matter 5.96, lime 15.94, magnesia 0.91, total sulphuric anhydrid 0.47, water-soluble sulphuric anhydrid 0.35 per cent.

Sugar. Three samples were tested, two of which were not adulterated. The third sample contained 0.86 per cent. of sulphuric acid, probably an accidental contamination acquired during transportation.

Tobacco Dust. The sample tested contained 1.22 per cent. of nicotin.

Vanilla Extract. A sample of *Thompson's Extract of Vanilla*, made by C. S. Lettell and Co., New York, contained 0.185 per cent. of vanillin with no coumarin.

Vinegar. Forty-four samples were tested, of which 31 conformed to the state standard. Three were below standard in acidity, 5 in solids and 4 in both acidity and solids. One sample contained 0.131 gm. of zinc per 100 cc.

Water. The sample tested showed 8.9 parts per million of chlorin, 414.0 parts of sulphuric anhydrid and less than 0.1 part of iron.

Whisky. Two samples were tested which contained no adulteration.

Wine. The single sample tested contained 11.90 per cent. of alcohol by volume.

Alcohol. The sample tested contained 89.7 per cent. of ethyl alcohol by volume.

B. K Bacili-Kil, made by General Laboratories, Madison, Wis. The material was an aqueous solution of alkaline earth and alkali hypochlorites; it contained approximately 3.41 gms. of available chlorin per 100 cc.; calcium, magnesium, sodium, potassium, and hypochlorites present; no heavy metals.

Police Cases. Three suspicious samples of drugs were sent to us by the local police. One was heroin hydrochlorid, one morphin sulphate, while the third was an abortion medicine consisting chiefly of ferrous iron and aloes. No ergot, savin, pennyroyal or alkaloids were detected.

Prescriptions. A sample of 3 gr. phenacetin in powders suspected of substitution was examined; the prescription was genuine. Another prescription supposed to consist of two parts bismuth subcarbonate and one part magnesium peroxid, was tested quantitatively and bismuth, magnesium, carbonates and peroxids were found.

Samples suspected of containing poisons. Twelve samples of this kind were examined. A milk suspected of containing carbolic acid was found to contain that drug. Another suspected milk was found normal in all respects. A sample of suspected raspberry jam contained no alkaloids or heavy metals. A sample of bird pie contained much free yellow phosphorus. A sample of wheat bran was tested with negative results. The contents of a cow's stomach were found to contain zinc; two samples of paint to which it was suspected the cow might have had access contained no zinc, one being a lead pigment and the other a mixture of lead chromate and Prussian blue. A sample of *Baby Buster Scratch Feed* alleged to have caused the death of 45 young chickens, was fed to two chickens for four days with no bad effects. A hen and a rooster, which were suspected of having been poisoned, were examined; no metallic poison was detected; the crops were gorged

with food and greatly distended, the lungs congested; the birds appeared to have died of suffocation rather than of poison. The contents of a dog's stomach were examined and a large quantity of mercury, probably derived from corrosive sublimate, was found. A red powder found scattered in a pig pen was tested for alkaloids and metallic poisons with negative results; iron, lime and sulphates were present in abundance.

SUMMARY OF EXAMINATIONS.

Sampled by Station:

Canned Beans	62	Prepared Flours	6
Bread (weights only)	265	Fruit Juices	5
Bread Materials	56	Infant Foods	2
Breakfast Foods	30	Jelly Powders	3
Brosia Meals	4	Malt Extracts	3
Chocolate and Cocoa	5	Malt Flours	4
Condensed Coffee	1	Temperance Beverages	4
Coffee Substitutes	6	Miscellaneous Foods	17
Cordials	27	Dried Vegetables	18
Diabetic Foods	8	Drug	1
Flavoring Extracts	9		
		Total	536

Sampled by Dairy Commissioner:

	Total.	Adulterated.		Total.	Adulterated.
Butter	14	3	Spices	52	7
Cocoa	1	0	Sugar	5	1
Cream	8	0	Vinegar	40	5
Eggs	6	6	Physician's Drugs	76	15
Hamburg Steak	34	14	Toilet Preparations	25	19
Milk	390	258*	Miscellaneous Drugs	6	1
Sausage	21	5			
			Total	678	334*

	Total.	Adulterated.
Sent by Private Individuals	140	44
Total samples examined	1354	

* Including 118 samples of milk deficient only in solids—not—fat.

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Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 201 JANUARY, 1918

ECONOMY IN FEEDING THE FAMILY

III

Food Oils and Fats

By E. M. BAILEY

CONTENTS

	Page
Salad Oils	
Olive Oil	204
Cotton Seed Oil	204
Corn Oil	204
Peanut Oil	204
Other Oils	205
Summary of results of inspection	205
Cooking Fats.	
Butter and its Substitutes.	
Butter	208
Renovated Butter	208
Oleomargarine	208
Nut Margarine	209
Milk-Butter Mixture	210

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Food Oils and Fats

Chemically all fats resemble one another in that they are combinations of fatty acids with glycerin. Physically they differ in that some are liquid while others are solid. The term "fixed" or "fatty oil" is generally applied to those fats which, at the ordinary temperatures, remain in the liquid condition, but chemical industry has eliminated this natural distinction by the introduction of the "hydrogenating" or "hardening" process which converts liquid oils into the solid state.

As food stuffs fats belong to the same category as sugars, i. e., they are chiefly energy producers, in contrast with protein foods which are, in addition, tissue builders. When taken with other food in the diet, fats (and sugars) have the property of reducing the protein requirements of the body and this is what is meant by their so-called protein-sparing action. The calorific (energy-producing) value of fat is about 2.25 times as great as that of either protein or sugar, and it is practically the same regardless of the particular source of the fat or oil, or whether it be of animal or vegetable origin. By accurate measurement it has been found that one ounce of fat yields 264 calories to the body. On the basis of calorific values, substitutions among fatty foods in the diet may be made with considerable freedom, but personal tolerance, preference, or prejudice, will influence the choice in this as in other types of foods.

Although so nearly alike in energy-producing capacity, the fats show differences in other nutritional aspects. We refer especially to the growth-promoting properties possessed by some fats and lacking in others. It has been shown[1] that butter possesses this peculiar efficiency to a marked degree and that the efficiency resides in the butter fat itself. This shows us an additional and important reason for the effectiveness of milk as a food for children. Other fats show this property, among them beef fat, and, as

[1] Osborne and Mendel Jour. Biol. Chem. **16**. 423–37 1913; ibid **20**, 379–90, 1915.

might be expected from their ingredients, the oleomargarines made of the so-called oleo-oil from beef fat. Lard and olive oil lack this peculiar property, as do those margarines also which are made from the commonly used vegetable fats and hydrogenated oils; as has been shown by Halliburton and Drummond.[1] The particular substances or properties responsible for this phenomenon are obscure, and as yet unidentified components of the fats. They have been detected in other types of food, and for lack of better definition have been called "vitamines" or "accessory diet factors."

Fatty foods not possessing the virtue just mentioned should not, however, be discriminated against on this account when used in the ordinary liberal diet, but it would appear to be inadvisable to eliminate butter entirely from the menu, particularly that of children.

We have referred already to the process of "hydrogenation," by which the physical and chemical characters of fats are modified, the conspicuous physical change being that liquid fats are hardened and converted into solids. The question of the wholesomeness and digestibility of fats so treated at once presented itself. The considerable amount of work which has been done on this subject has not resulted in anything to prejudice us against the use of products so treated. Upon this point Ellis[2] says: "It seems to be generally accepted by those who have investigated the matter, that the hydrogenated oils have as desirable a degree of digestibility as the oils from which they are derived." The debate as to their suitability for food has centered chiefly upon the presence of certain metals, more particularly nickel, which are used in the process of their manufacture. The amounts of nickel retained in the finished product, in the case of some hardened cottonseed oils, has been determined and quantities ranging from .020 to .075 milligrams per kilo (1,000 grams) found. The significance of such figures is better understood by comparing them with the quantities of nickel acquired by various foods prepared in nickel-lined cooking utensils which have been in common use for some years. Spinach contained from 25 to 27 milligrams per kilo; peas, 12 to 16; plums, 35; fruit cooked in 2% acetic acid (about one half the t..id strength of ordinary vinegar), 65 to 67; cabbage, 83; sour-..ut, 127; potato, 80. No injurious effects have been attributed

... of Physiol., LI., p 250.

...genation of Oils, Van Nostrand & Co., 1914, p. 144.

to the use of foods so prepared, yet it is seen that they contain amounts of nickel one thousand or more times greater than has been found in the hardened oils examined. However, it is perfectly obvious that this phase in the production of hydrogenated products should be carefully controlled.

The inspection of foodstuffs such as, of necessity, more and more engrosses the attention of this laboratory, involves tests for purity and tests to determine truthfulness of label or guaranty. When such inspections result in the detection of substances positively poisonous or deleterious to digestion and health, their value from the standpoint of public health is obvious to all. But instances of flagrant and vicious adulteration are largely passing out of the experience of the food control chemist of to-day, so that frequently the results of his labors lie within the realm of public health in its broader sense, which includes public economy. The substitution of one edible oil wholly or in part for another, and the sale of such substitute does not constitute a sin against the consumer's digestion, but it does defraud him of the difference in commercial values between the product he actually gets and that which he thinks he is buying. And now more than ever before he is anxious to protect himself in this direction. It is intended that our analyses should guide the consumer to intelligent purchasing; aid him to a better appreciation of comparative food values, and foster alertness to the deceptions of flashy labels and cunning advertising literature. Particularly at this time we desire to help him to co-operate in the program of economy that is being urged upon us.

These general considerations seem justified, in view of recent inquiries which have come to us on this subject. In addition we shall indicate briefly the source, preparation and composition of the principal fatty foods and summarize our accumulated experience with them. We shall include also some analyses not heretofore published, and some data, not our own, which may be of interest from a culinary standpoint.

Any classification of edible fats on the basis of their domestic uses will necessarily include the same fat in two or more classes, but for convenience we shall group them as follows: (1) Salad Oils. (2) Cooking fats and (3) Butter and its substitutes.

SALAD OILS.

Olive Oil. The oil supplied by the fruit of the olive tree has been used as a food by man since the earliest times. Grown originally in oriental countries, its cultivation and use have extended through Mediterranean countries to South America, and it is now grown to a considerable extent in the United States, notably in California and Arizona.

About 50% of the fleshy part of the olive fruit is oil. The best grades of oil are prepared from fruit picked by hand just before maturity. These are crushed and the oil removed by gentle pressure, the first run being called "Virgin" oil or Sublime. This is generally characterized by a distinct greenish tinge of color due to the chlorophyll which is associated with the oil in the plant cells. Genuine oil may, however, lack this characteristic and may be pale or even deep yellow. Admixtures of peanut, sesame, poppy seed, corn and cottonseed oils with olive oil are much less common than formerly, although blending of inferior grades; i. e., oil obtained from repressings of the olive pulp, with higher grades is practiced to some extent in Europe.

Cottonseed Oil. A keen competitor of olive oil for table use is the refined oil of the cottonseed. Although produced in countries of Europe, Asia and South America, it is essentially an industry of the United States, where methods of refining lead those of other countries. The oil is unfit for use until it has been refined, which process includes deodorizing, decolorizing and "chilling," the latter step removing the high-melting fatty constituent (stearin), which would cause the oil to "cloud" in cold climates.

Corn Oil. In the process of making starch and glucose from maize or Indian corn the germ of the seed is removed. This germ contains about 15% of oil and yields the corn oil now appearing in our market. It is golden yellow in color and has a pleasant odor and taste.

A sample of corn oil examined in this laboratory[1] was found to be mixed with other oils, chiefly cottonseed oil. Thus early has this product been dignified and commercially flattered by adulteration.

Peanut Oil. Next in importance is peanut oil, of which there is an increasing production in the United States. Like cottonseed

[1] Connecticut Food & Drug Report, 1905, p. 121.

oil it must be refined before it is marketable as a food oil. The refined oil has a distinct nutty flavor which commends itself to some tastes.

Other Oils. Oils of the poppy-seed, rape, sesame and sunflower are not used alone to any extent in this country, but some of them may occur in admixture with the oils described above, either as adulterants or in legally marked compounds.

The commercial value of the oils described is in about the following order: olive, peanut, corn, cottonseed, the values of the others being intermediate between peanut and corn oils.[1]

Summary of the Results of Our Inspections of These Products.

Between 500 and 600 samples of olive oil have been examined in this laboratory since 1897, chiefly represented by six inspections. The percentage of total adulteration decreased from a maximum of 40% found in 1900, to 13.7% in 1909. It has been found that this product, put up in sealed containers, is freer from adulteration than that purchased in bulk from druggists, although the quality of druggists' goods has shown improvement. The general improvement is due in part to more truthful labeling practiced since 1905.

The following tabulation[2], representing 448 samples, illustrates this point. No figures are given subsequent to 1909, because no representative number of samples has been examined in any one year.

Table I.—Summary of Inspections of Olive Oil.

From Grocers	Year	Not found adulterated	Adulterated	Per cent. Adulterated
	1897	37	23	38.3
	1900	45	28	38.4
	1905	19	0	0.0
	1906	25	0	0.0
	1907	7	0	0.0
	1909	44	0	0.0
From Druggists	1897	13	5	27.8
	1900	17	13	43.3
	1905	21	9	30.0
	1906	55	11	16.7
	1907	65	11	14.5

[1] Leach, Food Inspection and Analysis, p. 516.

[2] Conn. Food & Drug Report, 1909–10, p. 214.

The adulterations found in these inspections were cottonseed, sesame and peanut oils. Such admixtures, as we have noted above, do not constitute a menace to health, and, if properly labelled, would not constitute an infringement of law.

Products sold under the name of "Salad Oil" our examinations have shown to consist wholly or in part of cottonseed oil. Such products are legally labelled; they do not purport to be any single oil and are sold under a distinctive name. Our experience has been, however, that they are often sold upon request for olive oil.

No oil other than olive should be sold as "sweet oil."[1]

COOKING FATS.

The fats chiefly used by our grandmothers for culinary purposes were the rendered fats of hogs or beef, known respectively as lard or beef suet. To-day the housewife has a large array of shortening compounds at her disposal. These nearly always appear under trade names but may contain both the animal fats mentioned combined with a vegetable oil, such as cottonseed oil, or they may be entirely of vegetable origin. Other oils mentioned in the preceding section also occur in these compounds; any of them are adaptable to such use.

Our examination of some of the products in this group indicates their essential constituents to be as follows: Cotosuet[2], cottonseed oil and beef fat; Cottolene[3], cottonseed oil and beef fat; Korno[4], corn oil, cottonseed oil and a harder fat like stearin; Waverly shortening[5], beef stearin and cottonseed oil; Crisco, hardened vegetable oil, probably cottonseed; Vegetole, vegetable product containing cottonseed oil; Kuxit, vegetable product having the character of cocoanut fat; Wesson oil, cottonseed oil; Mazola, corn oil. A sample of Lard oil[6], said to have been used for deep frying, was found to contain about half its weight of mineral oil. This mixture is unique for food purposes but common as a lubricant.

Recent analyses of some of these fats are given in Table II.

[1] U. S. Food Inspection Decision No. 139; Conn. Rules & Regulations No. 43.

[2] Connecticut Food Report 1896, p. 23.

[3] Connecticut Food Report 1896, p. 23, 1900, p. 145.

[4] Connecticut Food Report 1906, p. 122.

[5] Connecticut Food Report 1909, p. 278.

[6] Connecticut Food Report 1900, p. 148.

TABLE II—ANALYSES OF COOKING FATS.

No.	Brand.	Moisture.	Protein (N x 6.25)	Ash.	Fat.	Free fatty acids as Oleic.	Refractometer reading at 40°C.	Reichert-Meissel No.	Halphen test.	Nitric Acid test.
		%	%	%	%	%				
8164	Wesson Oil	0.06	....	....	99.94	0.06	59.5	1.04	Red	Br. yellow
8165	Mazola....	0.00	....	....	100.00	0.17	62.5	0.86	Yellow	Red brown
8166	Vegetole...	0.02	0.38	0.02	99.58	0.15	59.5	0.45	Deep Red	Red brown
8167	Cottolene..	0.02	0.31	0.08	99.59	0.10	56.0	0.48	Deep Red	Red brown
8183	Crisco.....	0.20	0.19	0.05	99.56	0.18	54.7	0.50	Br. yellow	Br. yellow
8184	Kuxit.....	0.31	0.13	0.03	99.53	0.15	37.0	5.03	Yellow	Yellow

The analyses show that the samples contain only traces of moisture and are practically all fat. The percentage of free fatty acid is very low. These are the substances prominently concerned in the changes which result in rancidity. A rancid fat or oil is one in which a part of the fat has been decomposed, by enzyme action it is believed, into free fatty acids and glycerine. The action of light and air upon these fatty acids produces the substances of disagreeable taste and odor associated with rancidity. An excess of free fatty acids does not necessarily indicate rancidity, but the conditions are favorable for rancidity to occur.

Edible fats and oils should be kept in securely closed containers protected from sunlight. Oils are more likely to become rancid than are solid fats. It is claimed as one of the advantages of hydrogenation that fats so treated remain wholesome for long periods.

Particular attention, with respect to the presence of animal fats, has been given to those products claiming to be of purely vegetable origin. In none of them have we found evidence of cholesterol, a characteristic constituent of animal fats. The following appear to be pure vegetable products, as claimed: Wesson oil; Mazola; Vegetole; Crisco; Kuxit.

There are few precise physical or chemical data by which to decide the desirability of one fat over another for culinary use. The housewife learns and decides by her experience which to use, judging by the results obtained. One thing she avoids, however, is the use of "smoky" fats for deep frying. The reason for this is that such a fat or oil "smokes" and gives off disagreeable vapors,

which will be absorbed by the food, before the desired cooking temperature is obtained. A desirable fat for deep frying, then, should have a sufficiently high burning point or smoke test. Blunt and Feeney[1] have determined this for a number of common cooking fats and their results are given here as of interest. The temperatures given indicate the degree of heat acquired by the fat or oil at the time it begins to give off visible fumes or vapors. The degrees have been converted to the ordinary Fahrenheit scale.

TABLE III.

Cottonseed oil (Wesson)	451°
Snowdrift	450°
Crisco	448°
Leaf lard	430°
Butter fat	406°
Leaf lard heated 5 hrs.	405°
Bulk lard	381°
Olive oil	347°
Peanut oil (1)	323°
Peanut oil (2)	300°
Cocoanut oil	277°

The recognized temperature for deep frying is 350°—400° F. It is apparent, then, that those fats decomposing below that temperature are not well suited to this particular purpose.

BUTTER AND ITS SUBSTITUTES.

Butter. A typical butter contains about 15% of water and 85% of solids, of which 82.5% is milk fat and 2.5% other milk constituents and salt.

Renovated Butter. Renovated butter is made by melting genuine butter and separating the curd and water-soluble constituents of the original product. The fat so obtained is rechurned with milk or cream, or both, and no other substances added except salt. Like butter, it must contain 82.5% of milk fat. The object of this treatment is to save butter which has become rancid or fallen off from prime quality.

Oleomargarine is a product which varies as to proportionality of ingredients and, to some extent, as to character of ingredients, but generally it consists of oleo oil, neutral lard, butter, milk, cream and salt. Vegetable oils, such as cottonseed oil, may be used in the mixture.

[1] Jour. of Home Economics, 7, p. 535, 1915.

Rigid rules are in force to govern the sale of both renovated butter and oleomargarine, in order to protect the butter industry. The controversy which has existed for many years concerning oleomargarine and butter is unfortunate, as each might well have its proper place in the trade. The tax placed upon oleomargarine has increased the price to the consumer for this perfectly wholesome and nutritious product.

Nut Margarine. There have quite recently appeared upon the market a number of brands of nut margarines. These products consist chiefly of cocoanut fat, with admixtures of cottonseed or other vegetable oils. The fats are churned with milk* and salted, as in the preparation of butter. Color capsules accompany the package for the use of the consumer if he desires to color the product. It is not colored by the manufacturer as he is required to conform to regulations similar to those governing the sale of oleomargarine. The coloring we have found to be the vegetable color annatto, which is largely used for butter coloring.

Our analyses of some of these products are given in Table IV.

The analyses show some variation in water content but none contains excessive amount. All contain over 82.5% of fat. The ash varies considerably, due, in all cases, to the salt added. The free fatty acids are within normal limits for these products. Other tests must be interpreted with the knowledge that hydrogenation modifies them very materially. Nos. 8169 and 8170 are declared to contain 0.1% of benzoate of soda; they did not contain amounts in excess of this figure. No. 8168 made no statement as regards preservative; no preservative was found.

The diagnosis of mixtures of this kind is more difficult for the reason that hydrogenation changes the chemical as well as the physical properties of fats, so that their response to the usual tests is either modified or destroyed.

As we have stated elsewhere in this paper, nut margarines are supposedly composed of vegetable fats only, while in oleomargarine animal fats are used, with or without fats of vegetable origin. As in the case of cooking fats, we have looked particularly for evi-

* The flavor of butter is due to the action of lactic acid-forming bacteria in the milk from which it is churned. Nut margarine fats are ripened with milk to which a culture of such bacteria has been added to impart the flavor of butter. [Pickard. The Am. Food Jour., Jan. 1918.]

TABLE IV—ANALYSES OF BUTTER SUBSTITUTES.

Number	Brand	Moisture.	Protein (N x 6. 25.)	Ash.	Fat.	Free fatty acids as Oleic.	Refractometer reading at 40° C.	Reichert-Meissel No.	Halphen test.	Nitric Acid test.
		%	%	%	%	%				
	Nut Margarine.									
8168	A.1 Brand, Downey Farrell Co., Chicago...	10.84	1.25	4.51	83.40	0.45	40.0	7.00	Deep pink	Brown
8169	Cocoanut Brand, Nucoa Butter Co., Soho Park, N. J.	6.53	0.69	1.58	91.20	0.39	37.2	7.50	Yellow	Brown
8170	Providence Churning Co., Prov., R. I.	11.28	0.75	1.14	86.83	0.47	39.0	6.15	Yellow	Yellow
	Oleomargarine									
8171	Lily, Swift & Co..	1.67	0.56	0.41	97.36	0.74	52.0	1.50	Deep red	Red brown
8172	Premium, Swift & Co......	2.54	0.63	0.60	96.23	0.63	49.2	0.99	Red	Red brown
8173	Gilt Edge, John F. Jelke Co.	8.52	1.25	1.62	88.61	0.74	49.2	....	Pink	Red brown
9994	Good Luck, John F. Jelke Co.	9.20	1.00	3.08	86.72	0.50	49.3	....	Red	Red brown
8175	Silver Churn, Armour.........	4.90	0.56	1.44	93.10	0.80	51.0	1.30	Deep red	Red brown

dence of animal fats in the nut margarines but with negative results. There is nothing shown by our analyses inconsistent with the claim that they are vegetable products. They are very palatable preparations and may well be substituted for a part of the family butter supply, thereby conserving animal fats.

MILK-BUTTER MIXTURE.

The present is a fruitful time for invention and device designed to appeal to public economy. Such a device is one advertised of late, for which it is claimed that two pounds of butter or table butter can be made from one pound of butter and one pint of milk. While the fine distinction is made that you start with butter and milk and produce "table" butter, no distinction is made between the commercial values of the two substances. Both the expressed and implied thought is that from one pound of butter at (say) 55 cents per pound and one pint (pound) of milk at 7 cents per pint, two pounds of butter or "table" butter are produced, valued at $1.10.

The true story of this economic idea may be simply told by the following table:

Substance.	Composition.	Food Value Calories.	Commerical Value.
1 lb. Butter	85 parts solids, 15 parts water, 82.5 parts fat.	3478	$0.55
1 lb. Milk[1]	12 parts solids, 88 parts water, 4.0 parts fat.	305[2]	0.07
2 lbs. Milk-Butter mixture	97 parts solids, 103 parts water, 86.5 parts fat.	3783	1.10
or per lb. mixture	48.5 parts solids, 51.5 parts water, 43.3 parts fat.	1892	0.55

[1] One pint of milk may be called one pound.
[2] Basis of 4.5% sugar and 2.8% protein.

Whatever the finished product is called, it is watered butter, as a comparison of the composition and food value of the finished product with the original shows. As to the commercial value of the product, if it is worth the combined value of the ingredients, 62 cents, then the cost to the consumer per 100 calories is practically the same as in the original butter, 1.6 cents: if it is worth $1.10, then the consumer pays nearly twice as much; viz., 2.9 cents per 100 calories. The two pounds of mixture will "go as far" as two pounds of butter in the same sense that a pint of milk diluted with a pint of water will go as far as a quart of milk. The same economy will be effected by drinking the pint of milk and serving half portions of butter. This device may be looked upon as an ingenious method for serving half portions.

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 202 JANUARY, 1918

ECONOMY IN FEEDING THE FAMILY

IV

An Experience in Keeping Poultry in the City.

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to others as far as the editions permit.

NOTE BY THE DIRECTOR

The following pages give the experience of one of the Station staff in keeping a small number of fowls for more than a year near the center of New Haven.

In connection with the movement now undertaken to encourage families living in cities and large towns to keep very small flocks for their own supply of eggs and poultry, I believe the results of such an experience where the expense and income have been carefully recorded will be of value to many, however different their particular surroundings may be.

This paper is published in the hope that it may aid in this movement for increased food production.

E. H. JENKINS, *Director*.

Poultry Keeping in the City.

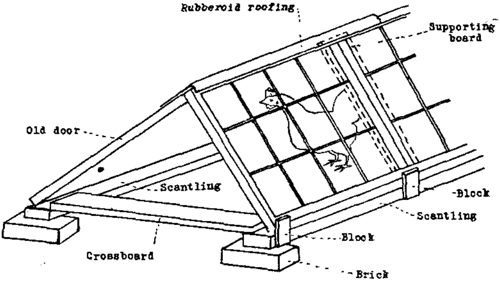
Persons living in cities and large towns have been urged to devote their gardens to the production of food and many have responded to this call by cultivating their backyards. More or less success has attended these efforts, but in many cases the outcome has been distinctly disappointing because sufficient sunshine is rarely available. Under such circumstances no amount of skill or care will avail, because, the sun being the source of all the energy which food supplies, seeds and tubers which form the substantial elements of our food cannot be produced without its aid. In all partly shaded places the crops are largely leaves which have but little food value.

Gardens where sunshine does not prevail throughout the greater part of the day will yield far better returns if poultry is raised and hens kept for eggs, and in this time when all waste of food should be avoided there is no better way of recovering the last scrap of table refuse than by feeding it to chickens. Every particle of meat left on bones from chops, steaks, etc., even if these first go through the soup kettle can thus be utilized, as well as all of the residues of vegetables of all kinds which are unsuitable for human consumption. Food of this kind is exactly what poultry need to supplement their grain rations.

I live in the center of New Haven and last year tried the dual experiment of keeping hens for eggs and raising young chicks, and in order to learn what the return from this form of backyard agriculture might be I kept an accurate account of expenses and returns. Although I had had no experience with poultry I found it distinctly profitable, for not only did I get a good supply of absolutely fresh eggs, but also fowls, roasters and broilers which in quality were equal to the very best that could be bought.

To make such an undertaking pay the first thing to be considered is overhead charges. A few birds cannot meet heavy expenses of this kind. The high board fences on two sides of my garden and a building on a third side made it necessary to buy only enough wire netting to fence in the fourth side. In this way a yard about forty feet square was provided. The building on one side of this

was an old brick barn in one corner of which was a box stall about ten feet square. By cutting a hole through the barn wall on the east side an exit to the hen yard was provided. This opened into a covered runway. For the north side of this runway three old doors that happened to be on hand were used. These were tilted over against a row of old window sash that met them tent-fashion and admitted all the south sun to the runway, the sash being nearly at right angles to the sun's rays. As support for the doors and sashes, pieces of scantling were laid on bricks resting on the ground, the scantling being kept in place by narrow cross boards nailed from one to the other. To make this intelligible the following sketch must be referred to:



Before putting the sashes in place the doors were supported at the proper angle by boards about six inches wide which were nailed to the scantling at the lower end and to the door at the upper end. These boards were so placed that the ends of adjacent sashes rested on them when in place and in this way rain was prevented from running into the cracks between the sashes.

To keep water out at the peak where the sashes rest against the doors, a strip of heavy roofing material was nailed to the doors but not to the sashes. In this way a perfectly tight runway was made at small expense with the sashes unfastened so that they can easily be removed in warm weather. By filling in with earth over the cross boards the ground level inside was raised above that outside and thus kept dry all winter. Owing to the small

space inside this runway a great deal of heat is accumulated in sunny days even in very cold weather, the thermometer on sunny days reaching 80°—100° when the temperature outside is much below freezing. As the earth inside never freezes to any noticeable extent and is always dry the hens dust themselves there all winter. I built this runway or sun parlor in one afternoon. It is about 20 feet long and gives plenty of room for over 30 hens. Of course such a sun parlor can be made of other materials, but probably old doors are as cheap as anything else, for they are tight and require no labor in fitting if all are of the same width. In winter the end of the sun parlor away from the hen house serves as the entrance and thereby draughts in the house are reduced to a minimum. In my old barn I found doors and sashes, as well as all necessary boards and scantling and as the box stall was ready at hand, quarters for my hens cost me only $2.50 which I had to pay for the 40 feet of poultry netting and $1.90 which I paid for the heavy roofing paper and some tar paper which was used to cover the floor of the house.

Not everyone would find so much of the needed materials about his place but with ingenuity similar quarters could probably be provided at small expense. One must be sure to remember that the cost of quarters must be kept small, for it takes a good many eggs even at the present high prices to pay for new boards and skilled carpenters. A large part of the return from the backyard agriculture comes from the chance it gives to a busy man to occupy his mind and leisure moments and to apply his ingenuity and business skill in a field wholly different from his daily routine. I can recommend it to anyone who has a taste for farm life and no other opportunity to gratify it. The labor involved is small but has the disadvantage of being constant. I solved this problem by giving one-quarter of the produce to a young man who lives nearby and seems satisfied with the arrangement and much interested in the experiment.

Just a year ago this venture was initiated by the purchase of twelve Rhode Island Red pullets on December 4th.* These proved to be what the seller represented them to be for they at once began to lay, and on December 7th twelve more were bought from

* Roosters should never be kept in town for they are noisy and have no effect on egg production; furthermore, infertile eggs keep better than fertile ones.

the same party. Being a novice in the business and not having time to spend in an attempt to buy at the lowest price, these cost me $48. Laying well through the winter and spring these hens gradually became broody. After setting three of them with poor success and trying to break up others, it seemed more profitable to kill and eat them as young fowls. Four were kept through the fall to see what they would return in the way of eggs, but up to the present time have laid only sixteen eggs. Under backyard conditions it seems decidedly more profitable to eat the hens as soon as they cease laying; otherwise they "eat their heads off" and, besides, the longer they are kept the greater the loss by death which, under backyard conditions, has been my greatest cause of loss of profit. Poultry should be either growing or laying eggs all of the time, otherwise they will not earn their living. Probably on the farm it pays to keep hens through the second and third year, but under city conditions this is evidently not the case. Owing to the diminishing size of the flock the egg production fell off during the summer, but at this season fresh eggs are relatively cheap. In August 24 White Leghorn pullets, hatched in February and raised at Storrs, were added to the flock in the hope that these might lay during the fall and winter.

The egg production was as follows:

	Number of hens at the end of each month.		Number of eggs.	Value.
1916, December	24		134	$8.30
1917, January	24		106	5.85
February	24		188	9.40
March	23		289	10.80
April	22		312	11.70
May	16		201	9.18
June	12		217	9.90
July	4		159	7.32
August	4 Rhode Island Reds	42	82	3.25*
	24 White Leghorns	40		
September	4 Rhode Island Reds	7	170	8.00*
	24 White Leghorns	163		
October	4 Rhode Island Reds	3	129	9.00
	23 White Leghorns	126		
November	4 Rhode Island Reds	0	136	9.62
	22 White Leghorns	136		
December	4 Rhode Island Reds	6	190	12.67
	20 White Leghorns	184		
			2,313	$114.99

* Part of these pullets' eggs were too small to be marketable, and al-
-nce was made therefor in estimating their value.

A financial statement of this experience in poultry keeping follows:

STATEMENT OF RECEIPTS AND EXPENSES.

Receipts:					
* Eggs (2,313).......		$114.99			
Meat:					
14 fowls...	$24.50				
6 broilers..	7.12				
2 roasters..	4.00				
		35.62			
				$150.61	
Expenses (excluding Labor):					
Equipment:					
Tar paper.......	$1.15				
Roofing paper....	.75				
Poultry netting..	7.41				
		$9.31			
Birds bought..........		84.00			
*Feed bought..........		57.40			
					150.71
On hand:					
Birds:					
20 White Leghorn pullets	@ $1.75..		$35.00		
6 R. I. Red pullets	@ 1.50..		9.00		
4 R. I. Red hens	@ 1.50..		6.00		
2 Plymouth Rock pullets	@ 1.50..		3.00		
1 Plymouth Rock cockerel	@ 2.00..		2.00		
			$55.00		
Feed..................................			4.50		
				59.50	
Gain..					59.40
				$210.11	$210.11

* Per lists.

The value set on these eggs will seem high to a farmer, but this was estimated on the basis of the cost of strictly fresh eggs delivered at my house and is what it would have cost me to buy them.

Up to this time six of the Rhode Island Reds have died and three have been very sick from canker. These last were cured by vigorous treatment with tincture of iodine. Of the White Leghorns four died. The causes of death were not ascertained with certainty, but two of the Leghorns apparently were "egg-bound."

This is a high death rate, but in a city is probably to be expected, as the sparrows and starlings that abound in towns may easily transfer infection from one place to another. I have succeeded in securing some return from these pests by trapping and feeding them to the chickens. Both sparrows and starlings were eaten with avidity. If back yard poultry raising is to become profitable, every bird that shows any sign of illness should be either quarantined or killed. I have a small quarantine coop and yard for this purpose and very lately by immediately isolating five pullets I prevented what appeared to be roup from spreading and saved all my infected birds.

During the late spring three hens were set on Rhode Island Red eggs, but the hatchings were poor as only eighteen chicks were obtained. All of these lived and grew vigorously. They were kept separate from the laying hens by fencing off a part of the lawn with poultry netting kept in place by dahlia stakes driven into the ground. A gate was hinged to a tree on one side and to a post firmly set on the other. In this way no injury was done to the lawn and the poultry netting and gate were later removed in a few minutes. A great many people living in cities have ideal places of this kind for raising young chicks, for trees and shrubs afford the shade they need and where there is not enough sunshine for a successful garden there is plenty of sun for chicks. Of the eighteen chicks thus raised nine were cockerels. Of these latter six were killed for broilers when three months old. As they had grown at the maximum rate they weighed nearly three pounds each when dressed and although large for broiling they were excellent when thus cooked, far superior to the ordinary under-fed farm chicken usually sold in the markets. Two of the remaining cockerels were killed when about five months old and weighed almost six pounds each, dressed. These made as fine roasting chickens as were ever eaten. The secret of success in raising such birds for the table is to give them plenty of food, both dry mash and scratch feed, as well as all the waste soup meat and similar refuse from the kitchen. They should also have plenty of lawn to range over for chickens need much grass and other fibrous vegetable food if they are to remain healthy and grow fast. The faster they grow the cheaper and better their meat. As grass usually grows fast in summer, a lawn furnishes a large amount of this kind of food without suffering damage. For the table only the large

varieties of chickens should be raised, such as Rhode Island Reds, Plymouth Rocks, White Wyandottes, etc. The hens of all these breeds are good layers and the pullets should be kept for this purpose.

Now as to the costs excluding labor:

Dec.	7, 1916,	100 lbs. corn	$2.35
		10 lbs. oyster shells	.10
		grit	.60
Feb.	1, 1917.	100 lbs. corn	2.35
		25 lbs. oyster shells	.25
March	31,	100 lbs. corn	2.55
April	20,	3 sittings eggs	1.50
May	11,	50 lbs. chick food	2.10
	20,	100 lbs. corn	3.00
June	10,	200 lbs. corn	6.00
	13,	grit	.15
		oyster shells	.10
	18,	50 lbs. chick food	2.15
July	1,	50 lbs. chick food	2.20
	20,	50 lbs. chick food	2.00
		50 lbs. scratch feed	2.00
		insect powder	.15
Aug.	15,	100 lbs. scratch feed	4.40
Oct.	10,	50 lbs. scratch feed	2.30
Nov.	1,	25 lbs. scratch feed	1.20
	8,	100 lbs. scratch feed	4.30
		100 lbs. mash	3.60
		25 lbs. meat scrap	1.25
Dec.	8,	100 lbs. scratch feed	4.30
		100 lbs. wheat	4.50
		1 bale oat straw	2.00
			$57.40

As no charge has been made for labor and as the equipment cost less than $10, because so much old material was used, the financial results of this experiment are not very inviting to one who views the problem of backyard poultry farming from a purely financial standpoint. Viewed from the point of food production, however, the results of these efforts are in my opinion far greater than from backyard vegetable gardening, for I have also tried

that with much greater success than most of my friends have had, largely owing to exceptional conditions.

This is the experience of a greenhorn and doubtless some other greenhorn might have better luck, but however that may be I produced a good deal of real food at a considerable profit per hen. In an undertaking of this sort one must count his reward for the labor involved as consisting in a pleasant out-door occupation and the satisfaction that his pleasure has resulted in an increase in the food supply instead of a decrease, as results from most other forms of amusement.

The experience gained in this experiment has convinced me that by raising young chicks in backyards by those who have grounds with sufficiently extensive lawns a relatively large amount of food can be produced and that this is the most productive use that can be made of such places. Many people have lawns shaded with trees and shrubbery which they do not wish to destroy by converting them into vegetable gardens. Furthermore, such places are usually so shaded that seed, fertilizer and labor are wasted and no useful purpose is served by planting. These back lawns are ideal places for young chicks and the younger members of the family can find no more useful occupation than in caring for them. It surprised me to find how chickens throve on my back lawn and how well the lawn appeared after they were removed in the fall. Next summer I shall try to raise at least 100 chicks on my lawn.

I would buy good vigorous incubator chicks instead of raising them under a hen, if I did not fear that cats and rats would destroy them unless watched and protected by a mother hen. In any event I shall give each hen as many chicks as she can cover and if necessary I shall buy some hens with broods early in the season and reinforce these broods with incubator chicks.

Where the premises are restricted in area and do not include lawns of considerable size it would be inadvisable to undertake the rearing of chicks. Under such conditions efforts should be limited to egg production.

SEVENTEENTH REPORT

OF THE

STATE ENTOMOLOGIST

OF

CONNECTICUT

FOR THE YEAR 1917

(Being Bulletin 203, Connecticut Agricultural Experiment Station)

BY

W. E. BRITTON, Ph.D.

State Entomologist

New Haven, Conn.

1918

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF.

BOARD OF CONTROL.

His Excellency, Marcus H. Holcomb, *ex-officio*, *President.*

James H. Webb, *Vice President*..............................Hamden
George A. Hopson, *Secretary*..............................Wallingford
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Chemistry. Analytical Laboratory.	†John Phillips Street, M.S., *Chemist in charge.* E. Monroe Bailey, Ph.D., C. B. Morison, B.S., C. E. Shepherd, M. d'Esopo, Ph.B., *Assistants.* Hugo Lange, *Laboratory Helper.* V. L. Churchill, *Sampling Agent.*
Protein Research.	T. B. Osborne, Ph.D., D.Sc., *Chemist in Charge.* Miss E. L. Ferry, M.S., *Assistant.*
Botany.	G. P. Clinton, Sc.D., *Botanist.* E. M. Stoddard, B.S., *Assistant Botanist.* Miss F. A. McCormick, Ph.D., *Scientific Assistant.* G. E. Graham, *General Assistant.*
Entomology.	W. E. Britton, Ph.D., *Entomologist; State Entomologist.* B. H. Walden, B.Agr., *First Assistant.* Q. S. Lowry, B.Sc., I. W. Davis, B.Sc., M. P. Zappe, B.S., *Assistants.* Miss G. A. Foote, B.A., *Stenographer.*
Forestry.	Walter O. Filley, *Forester; also State Forester and State Forest Fire Warden* A. E. Moss, M.F., *Assistant State and Station Forester.* Miss E. L. Avery, *Stenographer.*
Plant Breeding.	Donald F. Jones, M.S., *Plant Breeder.* C. D. Hubbell, *Assistant.*
Vegetable Growing.	W. C. Pelton, B.S.

* Died January 10, 1918.
† Absent on leave, In U. S. Service.

CONTENTS

	Page
Report of Receipts and Expenditures	231
Summary of Inspection and Office Work	232
Publications of Entomological Department, 1917	232
Department Staff	233
Chief Lines of Work	235
Inspection of Nurseries	236
Nursery Firms in Connecticut Receiving Certificates in 1917	237
Inspection of Imported Nursery Stock	240
Inspection of Apiaries	242
Suppression Work Against the Gipsy and Brown-Tail Moths	246
Brown-Tail Moth Work	247
Gipsy Moth Work	248
Parasites	249
Present Status of Parasite Work in Connecticut	250
Details of Gipsy Moth Work by Towns	253
Statistics of Infestations	258
Experiments in Spraying Apple Orchards to Control Aphids and False Red-Bug	259
The Striped Cucumber Beetle	262
Distribution and History	262
Food Plants	263
Injury	263
Life History	264
Description	266
Parasites	267
Field Tests in 1917	267
Methods of Control	268
Cultural Practices	269
Protective Methods	270
Repellents	270
Arsenical Poisons	271
Contact Poisons	271
Results	271
Summary	272
Literature	272
The Imported Pine Sawfly	273
Identity	274
Publications from this Department	274
Distribution in Connecticut	275
Distribution in the United States	275
Distribution and Damage in Europe	276
Injury to Trees	276
Life History and Habits	277
Number of Broods	277
Food Plants	278
Molts	279
Description	280
Egg-Laying Habits of the Female	281
Number of Eggs Laid	282
Parthenogenesis	282
Parasites	283
Probably Introduced on Nursery Stock	284
Danger to the Pine-Growing Industry in the United States	285
Control Measures	286
Summary	287
Literature	288
Outbreak of the Pink and Green Potato Aphid	290
Danger from the Potato Aphid	291
Prior Connecticut Records of this Species	292
Distribution in the United States	292
Injury	293
Habits and Life History	294
Host Plants	295
Description	295
Parasites and Natural Enemies	298

	Page
Control Methods	300
Literature	301
A Cockroach Pest of Greenhouses	302
Damage and Habits	303
Distribution	304
Probable Manner of Introduction	305
Synonymy	306
Description	306
Egg-Laying Habits	307
Is the Species Parthenogenetic?	307
Control Experiments	307
Effective Poison Baits	308
Repellents	312
Traps	312
Kerosene Spray	313
Literature	313
Eradicating the Little House Ant or Pharaoh's Ant from a Dwelling House	314
A New Fruit Pest in Connecticut	315
Injury	317
Life History	318
Possible Control Measures	318
The Fall Web-Worm	319
Relationship to Other Insects	319
Injury and Habits	320
Food Plants	320
Number of Broods	321
Life History	321
Description	322
Parasites and Natural Enemies	323
Control Methods	323
Literature	324
The Hickory Tussock Moth and Other Closely Allied Species	325
The Walnut Caterpillar	326
The Yellow-Necked Caterpillar	328
The Red-Humped Caterpillar	329
Some Insects Injuring Stored Food Products in Connecticut	330
The Grain Beetles	331
The Flour and Meal Moths	335
The Grain Moths	337
Other Insects Occasionally Attacking Foods	338
Control Methods	339
Summary	343
Mosquito Work in Connecticut during 1917	345
Entomological Features of 1917	356
Miscellaneous Insect Notes:	359
Sawfly Borer in Poplar	359
Sawfly Larvae on Austrian Pine	360
Army Worm	360
Long-Horned Beetle a Borer in White Pine	360
Leaf Roller on Virginia Creeper	360
A Sawfly on Balsam Fir	360
Twig Borers in Sourwood, Dogwood and Azalea	360
The Sinuate Pear Borer in Connecticut	361
Harrisina americana on Virginia Creeper	361
A Pest of Wheat Middlings	361
Weevil in Evening Primrose	361
A Leaf Beetle on Peas	361
The Cynthia Moth at Stonington	362
Elm Leaf Beetle More Abundant	362
Eggs of the European Lackey Moth on Nursery Stock from Holland	362
Disappearance of The Tent Caterpillar	363
A Bark Miner of Apple Twigs	363
A Leaf-Roller on Spiraea	364
Abundance of Grasshoppers	364
An Injurious Weevil Attacking Red Pine	365
Wheat Midge Injuring Rye in Connecticut	366

BULLETIN 203

SEVENTEENTH REPORT

OF THE

State Entomologist of Connecticut

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

I have the honor to submit the following pages as my seventeenth report as State Entomologist of Connecticut for the fiscal year ending September 30, 1917. This report contains brief accounts of the various lines of inspection and control work placed under the State Entomologist by legislative enactment; the chief entomological features of the season; and several special articles dealing with injurious insects which embody the results of study and observation by members of the staff.

Respectfully submitted,

W. E. Britton,

State Entomologist.

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST FROM OCTOBER 1ST, 1916, TO SEPTEMBER 30TH, 1917.

RECEIPTS.

From E. H. Jenkins, Treasurer	$4,000.00	
Account of 1916, Balance	974.10	
State Comptroller, Apiary Inspection Account	10.50	
" " Gipsy Moth Control Account	434.00	
		$5,418.60

EXPENDITURES.

For Field, Office and Laboratory Assistance:

B. H. Walden, salary	$875.00	
Q. S. Lowry, "	1,141.62	
M. P. Zappe, "	1,083.31	
J. S. Miller, "	72.00	
J. K. Lewis, "	21.00	
Alice C. Heath, "	277.42	
Grace A. Foote, "	397.75	
Other stenographic work	2.00	
		$3,870.10

EXPENDITURES (*Continued.*)	$3,870.10	
Printing and Illustrations	14.10	
Postage	56.82	
Stationery	16.78	
Telegraph and Telephone	9.54	
Office Supplies	102.20	
Library	40.43	
Laboratory Supplies	49.74	
Express, Freight and Cartage	3.45	
Tools and Supplies	83.68	
Travelling Expenses	185.05	
Balance, cash on hand	986.71	
		$5,418.60

Memorandum:—This account of the State Entomologist has been audited by the State Auditors of Public Accounts. The items of $10.50 and $434.00 credited above as received from the State Comptroller are transfers from other appropriations to cover time expended on work for which such appropriations were made.

SUMMARY OF INSPECTION AND OFFICE WORK.

325 samples of insects received for identification.
86 nurseries inspected.
86 regular certificates granted.
40 parcels of nursery stock inspected and certified.
49 orchards and gardens examined.
163 shipments, containing 682 cases, 1,706,977 plants imported nursery stock inspected.
45 shipments, or 28 per cent. found infested with insects or fungi.
473 apiaries, containing 4,596 colonies, inspected.
79 apiaries, containing 219 colonies, found infested with European foul brood.
2 apiaries, containing 8 colonies, found infested with American foul brood.
7 apiaries, containing 9 colonies, found infested with pickled or sac-brood.
2026 letters written on official work.
435 post cards written on official work.
171 reports of inspection to Federal Horticultural Board.
890 bulletins, etc., mailed on request or to answer inquiries.
84 packages sent by mail or express.
30 lectures and addresses made at institutes, granges, etc.

PUBLICATIONS OF ENTOMOLOGICAL DEPARTMENT, 1917.

By W. E. Britton:

Sixteenth Report of the State Entomologist (Part II of Station Report for 1916); 82 pages, 3 figures, xvi plates; 10,000 copies distributed in April.

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Report of Committee on Injurious Insects, Proceedings Connecticut Pomological Society, page 20. (3½ pages) 1917.

Report of Committee on Injurious Insects, Proceedings Connecticut Vegetable Growers' Association, page 17 (2 pages) 1917.

Recent Anti-Mosquito Work in Connecticut (2 pages), Journal of Economic Entomology, Vol. 10, page 109, 1917.

Bulletin 195, Insects Injuring Stored Food Products in Connecticut, 21 pages, 18 figures; 10,500 copies distributed in August.

Mosquito Control Work in Connecticut in 1916. Proceedings Fourth Annual Meeting of the New Jersey Mosquito Extermination Association, page 184 (6 pages) 1917.

By B. H. Walden:

Simple Apparatus for Insect Photography. (6 pages, 1 plate) Journal of Economic Entomology, Vol. 10, page 25, 1917.

By Quincy S. Lowry:

An Outbreak of the Eight-Spotted Forester, *Alypia octomaculata*, in New Haven, Conn. (2 pages) Journal of Economic Entomology, Vol 10, page 47, 1917.

By Irving W. Davis:

The Present Status of the Gipsy and Brown-Tail Moths in Connecticut, (2 pages) Journal of Economic Entomology, Vol. 10, page 193, 1917.

By M. P. Zappe:

Egg-Laying Habits of *Diprion simile* Hartig. (2 pages) Journal of Economic Entomology, Vol 10, page 188, 1917.

Department Staff

W. E. Britton, Ph.D. .... *State and Station Entomologist.*
B. H. Walden, B.Agr. .... *First Assistant.*
Quincy S. Lowry, B.Sc. .... *Assistant.*
Max P. Zappe, B.S. .... *Assistant.*
Irving W. Davis, B.Sc. ... *Assistant and Deputy in Charge of Moth Work.*
J. T. Ashworth .... *Assistant in Moth Work.*
Miss Grace A. Foote, B.A. .... *Clerk and Stenographer.*

H. W. Coley, Westport
A. W. Yates, Hartford } .... *Apiary Inspectors.*

Messrs. Walden, Lowry, Davis and Zappe have continued as assistants and have all aided in the inspection of nursery stock, as well as in the general work of the department.

Mr. Walden was detailed as deputy to the Director of the Station to look after the mosquito drainage work under the new law,

and was thus occupied throughout the six summer months. Half of his yearly salary will now be paid from the insect pest appropriation and the other half from Station funds, or from the appropriation for mosquito control work. Mr. Walden spent most of his time in the field during the summer but was able to do some of the general photographic work of the department and helped inspect some of the nurseries.

Mr. Lowry has been engaged in the inspection of growing nursery stock, imported nursery stock, and has studied the insects attacking vegetable crops. He conducted experiments at the Station farm at Mt. Carmel in controlling the striped cucumber beetle and other insects attacking cucurbitaceous plants, but on account of an operation for appendicitis was obliged to be in the hospital for about six weeks in May and early June.

Mr. Davis has continued in charge of the work of suppressing the gipsy moth and the brown-tail moth, and has been located at Danielson throughout the year. He has inspected most of the nurseries and some of the imported nursery stock in the eastern portion of the State. On account of an operation, he was unable to aid in the general inspection of the larger nurseries as in former years.

Mr. J. T. Ashworth has been employed since June 1 as assistant to Mr. Davis. Mr. Ashworth also resides in Danielson.

Mr. Zappe has helped inspect nurseries and imported stock, has been in charge of the insectary, and has worked on the collections. He has also collaborated with the entomologist in studying the life history of the European pine sawfly, *Diprion simile*, and in some orchard spraying experiments for the control of the false apple red-bug. Mr. Zappe has also investigated and devised methods of controlling a southern cockroach, *Pycnoscelus surinamensis*, which has caused much damage in the greenhouses of A. N. Pierson, Inc., Cromwell, and the little red ant or Pharaoh's ant, *Monomorium pharaonis*, an annoying pest in a large dwelling house in Hartford.

Miss Foote has done the necessary stenographic and clerical work and has also indexed much literature to facilitate the looking up of references. She has also kept records and made out the reports to the Federal Horticultural Board. From November to April she was called home by sickness and the work was done by Alice C. Heath.

Mr. J. Kirby Lewis was employed for a few days in August, and Mr. J. S. Miller for three weeks in September, to help inspect nurseries.

Messrs. H. W. Coley and A. W. Yates have made the apiary inspections as in preceding years on a *per diem* basis.

All mentioned above who have aided in the work of the department have labored conscientiously and their efforts are duly appreciated.

New Equipment.

No new equipment of importance has been obtained for the office or laboratory during the year. In the gipsy moth work, the Ford car was exchanged for a new one in the spring and a new "Buick four" was purchased early in the summer.

Chief Lines of Work.

As has been the case for several years, the required routine and control work continues to monopolize the time and efforts of the staff. This includes the annual systematic inspection of nurseries, and the inspection of orchards, fields, gardens and greenhouses on request. In co-operation with the Federal Horticultural Board all woody field-grown stock imported into Connecticut from foreign countries has been inspected.

The work of suppressing the gipsy and brown-tail moths is placed in charge of the State Entomologist. This work has been in immediate supervision of Mr. Davis, aided by Mr. Ashworth, though all expenses are paid upon the order of the State Comptroller, on duly receipted, certified and approved vouchers.

The inspection of apiaries is also placed by law upon the office of State Entomologist, though, like the gipsy moth work, the bills are paid from Hartford.

The department has been concerned with the anti-mosquito work, not only around New Haven, but also of the whole state. Mr. Walden has been in immediate charge.

Studies of the European pine sawfly, *Diprion simile*, have been continued and are now about finished and ready for publication.

Means for controlling a pest of cockroaches in greenhouses, and the little red ant or Pharaoh's ant in dwelling houses, have been worked out by Mr. Zappe.

Mr. Zappe and the Entomologist have conducted spraying experiments at Clintonville and at Milford to control apple aphids and apple red-bugs.

The study of insects attacking vegetable crops has been continued by Mr. Lowry, who has prepared the paper published in this report on the Striped Cucumber Beetle. Further work will be done on squash and cucumber insects.

Considerable time was put upon editing, indexing and reading proof of the "Hymenoptera of Connecticut," which was issued in March as Bulletin No. 22 of the Connecticut State Geological and Natural History Survey.

The Entomologist has also prepared, and later revised for publication, A Check List of The Insects of Connecticut, which will be published by the Survey. He has also written a portion, and edited the remainder, of a series of papers on the "Hemiptera of Connecticut," which will be published by the Survey at some time in the future.

The outbreak of the potato aphid was sudden, widespread, and caused much damage. On account of the war and the campaign to plant vegetable gardens in city back yards and on farms, the correspondence of the office, as well as telephone inquiries, required more than the usual attention.

The following pages of this report give in greater detail an account of the work of the department for the year.

INSPECTION OF NURSERIES.

Nursery inspection was commenced on August 6, and finished on October 15, and the work was done by Messrs. Lowry, Zappe, Davis, Walden, J. S. Miller, J. K. Lewis, G. A. Root and Britton. Mr. Root was employed for the summer by the State Forester in suppressing the white pine blister rust, and was detailed to examine the currant bushes and pine trees in the nurseries for this disease. Though it had been found in two nurseries previously, no signs of it occurred in any of them at the time of the annual inspection.

The Ford car was spared from the gipsy moth work from August 11 to October 5 and was used to transport the men. It was especially useful in reaching the larger nurseries and even others which are not adjacent to railroad and trolley lines.

All nurseries were given a thorough inspection, and on the whole were found to be in good condition. All infested trees and shrubs were marked and the owner was informed regarding them and directed to treat or destroy those having pests liable to be distributed on nursery stock.

In 29 nurseries no pests were found. The following pests were found in the number of nurseries indicated: Oyster-shell scale, 44; San Jose scale, 23; scurfy scale, 14; spruce gall aphid, 14; poplar canker, 9; tulip tree scale, 4; pine leaf scale, 3; lilac borer, 3; chestnut blight, 2; imported European pine sawfly, 2; elm scale, 2; *Lina scripta*, 2; pear leaf blister mite, 2; Oak leaf roller, 2; apple borer, ash borer, linden borer, shot hole borer, Abbott's sawfly, juniper web-worm, *Lina japonica*, peach leaf miner, *Lecanium*, pit-making oak scale, rose scale, and West Indian peach scale, 1 each.

Of course, such common insects as aphids, fall web-worm, white-marked tussock moth, *Datana ministra*, red-humped caterpillar and leaf hoppers were found almost everywhere, and are not taken into account except in severe infestations.

In addition to the regular inspections, a number of parcels have been examined and certified. These were to be shipped by persons not in the nursery business, or perhaps the stock was not covered by the regular certificates, and these parcels were refused by the transportation companies unless accompanied by certificates. During the year 40 such parcel certificates were issued.

Two nurseries were inspected twice, in addition to the examinations for pine blister rust, which were made in May and June in the several nurseries having pine trees.

Of the 83 names on the nurserymen's list for 1917, four are new since the publication of the last year's list. Two have dropped the nursery business, three firms have changed names, and two have not yet cleaned up their nurseries so as to receive certificates.

The area devoted to growing nursery stock in Connecticut is about the same as last year, being slightly curtailed on account of the scarcity of labor, and amounts to about 1,500 acres. The list for 1917, together with date and number of certificate, and acreage of each, is given below:

Nursery Firms in Connecticut Receiving Certificates in 1917.

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Alderson & Dell, The Misses	Greenwich	1	Sept. 29	842
Barnes Bros. Nursery Co.	Yalesville	155	Oct. 5	853
Beattie, Wm. H.	New Haven	1	Oct. 9	864
Bertolf Bros.	Sound Beach	25	Oct. 16	871
Bowditch, J. H.	Pomfret Center	8	Sept. 12	819
Bradley, H. M	Derby	1	Dec. 18	895

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1917--*Con.*

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Bradley, Smith T.	New Haven	1	Nov. 22	887
Brainard Nursery & Seed Co.	Thompsonville	6	Oct. 3	850
Braley & Co.	Burnside	1	Sept. 26	833
Bretschneider, A.	Danielson	1	Sept. 5	813
Brooks Bros.	Westbrook	2	Oct. 11	867
Burr & Co., C. R.	Manchester	300	Sept. 15	822
Burroughs, Thos. E.	Deep River	3	Sept. 17	824
Chapman, C. B.	Groton	1	Oct. 1	844
Chapman, C. E.	North Stonington	2	Sept. 28	835
Conine Nursery Co., The F. E.	Stratford	50	Oct. 3	849
Conley, L. D.	Ridgefield	3	Sept. 25	830
Conn. Agricultural College (Prof. S. P. Hollister)	Storrs	2	Oct. 8	860
Conn. Agri. Experiment Station (W. O. Filley, State Forester)	New Haven	1	Sept. 25	832
Conway, W. B.	New Haven	1	Oct. 8	858
Crofut & Knapp Farm	Norwalk	60	Oct. 9	862
Cross Highway Nurseries	Westport	6	Nov. 23	889
Dallas, Inc., Alexander	Waterbury	3	Oct. 25	875
Dowd, Frank C.	Madison	3	Nov. 26	891
Elm City Nursery Co., Woodmont Nurseries, Inc.	Woodmont & New Haven	155	Sept. 15	823
Fairfield Landscape & Nurseries Co.	Cannon Station	5	Nov. 10	881
Gardner's Nurseries	Cromwell	10	Sept. 14	821
Geduldig, G., Estate of	Norwich	1	Oct. 2	847
Goodwin Associates, Inc., The James L.	Hartford	1	Sept. 25	828
Hartford Park Commissioners (G. A. Parker, Supt.)	Hartford	3	Sept. 28	837
Heath & Co., H. S.	Manchester	50	Sept. 7	817
Hilliard, H. J.	Sound View	1	Sept. 28	836
Holcomb, Irving	Simsbury	1	Sept. 12	818
Horan & Son, Jas.	Bridgeport	1	Oct. 3	851
Houston & Sons, J. R.	Mansfield	6	Oct. 8	861
Hoyt's Sons Co., The Stephen	New Canaan	300	Oct. 19	873
Hubbard & Co., Paul M.	Bristol	12	Oct. 20	874
Hunt & Co., W. W.	Hartford	12	Sept. 29	839
Itravaia, Joseph (2)	Middletown	1	Sept. 17	825
Kelee, Charles	Darien	3	Oct. 3	852
Kelley, James	New Canaan	1	Sept. 7	814
Kellner, Herman H.	Danbury	1	Oct. 2	846
Long, J. A.	East Haven	1	Nov. 26	893
Mallett & Co., G. A.	Bridgeport	1	Nov. 10	882

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1917--*Con.*

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Maplewood Nurseries (T. A. Peabody, Mgr.)	Norwich	1	Oct. 2	848
Marigold Farm (H. Kelley, Prop.)	New Canaan	1	Sept. 7	815
McDermott, E. F.	Windsor	1	Sept. 25	829
Meier & Gillette	West Hartford	2	Nov. 26	892
Munro, Charles	New Haven	1	Sept. 29	841
New Haven Nurseries Co.	New Haven	10	Oct. 16	870
New Haven Park Commissioners (G. X. Amrhyn, Supt.)	New Haven	30	Nov. 12	883
New London Cemetery Association (F. S. Newcomb, Pres.)	New London	2	Oct. 1	845
North-Eastern Forestry Co.	Cheshire	20	Sept. 22	826
Norwich Nurseries (O. E. Ryther, Prop.) (2)	Norwich	6	Oct. 30	878
Oakland Nurseries	Manchester	50	Sept. 7	816
Palmer, L. M., Estate of	Stamford	5	Nov. 22	888
Park Gardens	Bridgeport	1	Nov. 7	879
Pequod Nursery Co.	Meriden	15	Oct. 5	855
Phelps, J. Wesson	Bolton	1	Sept. 29	843
Phelps & V. T. Hammer Co., The J. W.	Branford	2	Oct. 11	866
Pierson, A. N., Inc.	Cromwell	45	Sept. 28	834
Platt Co., The Frank S.	New Haven	1	Nov. 12	884
Pomeroy, Edwin C.	Northville	1	Sept. 25	831
Purington, C. O.	Hartford	1	Sept. 25	827
Quality Seed Store	Stamford	1	Oct. 10	865
Raab, Joseph O.	Ansonia	1	Oct. 5	856
Reck, Julius	Bridgeport	1	Oct. 13	868
Roehrich, W. G.	Stratford	1	Oct. 15	869
Saxe & Floto	Waterbury	1	Nov. 23	890
Scott, J. W.	Hartford	5		
Sierman, C. H.	Hartford	3	Oct. 25	876
South Wilton Nurseries	South Wilton	5	Sept. 14	820
Steck, Charles A.	Bethel	1	Sept. 29	838
Stratfield Nursery Co.	Bridgeport	4	Nov. 9	880
Traendly & Schenck	Rowayton	2	Oct. 6	857
Upson, R. E.	Marion	3	Nov. 17	886
Verkade, H.	New London	1	Nov. 12	885
Vidbourne & Co., J.	Hartford	7	Sept. 29	840
Wallace, Arthur T.	Wallingford	1	Oct. 16	872
Wallingford Nurseries	Wallingford	10	Oct. 5	854
Wilson & Co., C. E.	Manchester	7	Sept. 5	812
Yale University Forest School	New Haven	2	Oct. 9	863
Young, Mrs. Nellie A.	Pine Orchard	1	Oct. 30	877
		1,461		

INSPECTION OF IMPORTED NURSERY STOCK.

On account of the war, fewer shipments, cases and plants were received than during 1916, as the following figures show:

Year	Shipments	Cases	Plants
1916	291	2,102	1,998,178
1917	163	682	1,706,977

These shipments have entered the country under the system of permits and notices adopted by the Federal Horticultural Board five years ago, and which is still in force.

Reports have been made to the Board of 171 shipments, 8 of which were not inspected; 3 were refused by consignee, 2 contained seeds, 2 herbaceous stock, and one was destroyed by consignee.

The stock came from about the same countries and in about the same proportions as in 1916, except that from Belgium a larger proportion of shipments was received. Most of the stock grown in Belgium was taken into Holland and shipped from Holland ports. The figures for these shipments are given in in the following table:

SOURCES OF IMPORTED NURSERY STOCK, 1916–1917.

Country	No. of Shipments	No. of Cases
Holland	57	249
Belgium	56	234
France	21	138
Ireland	12	14
England	9	32
Scotland	3	3
Japan	3	9
Ontario	1	2
Bermuda	1	1
Total	163	682

Most of this stock was inspected by Mr. Lowry, but Messrs. Zappe, Davis, Walden and Britton helped. The total time required in making these inspections amounts to 120 days of 7½ hours each, or about two-fifths of the working time of an entire year. The cost of this work, including time and travelling expenses, has amounted to about $663.00, or slightly more than half that of last year, and has been paid on duly accredited vouchers by order of the State Comptroller from the appropriation for suppressing gipsy and brown-tail moths and for inspecting imported nursery stock.

Of the 163 shipments inspected, 45 shipments, or about 28 per cent., were found infested with insects or fungi, some of which are pests. Among others, perhaps one of the most important discoveries was an egg-mass of the European lackey moth, *Malacosoma neustria* Linn., a defoliator of fruit trees, oak, elm, rose, poplar, hawthorn and hornbeam.* Had these eggs not been intercepted, they might have hatched and started a colony of the lackey moth in this country.

Some of the insects were identified here, and some of the fungi were determined by Dr. G. P. Clinton, Botanist of this Station. The other insects and fungi were identified by specialists in the Bureaus of Entomology and Plant Industry of the U. S. Department of Agriculture, Washington, D. C.

The information regarding these infestations occurs in the following list:

PLANT DISEASES AND INSECTS ON IMPORTED NURSERY STOCK, 1916–17.

45 Shipments infested.

Plant Diseases.

Exobasidium vaccinii on Azalea. (29 shipments.)

Bier & Ankersmit, Melle, Belgium; G. J. Bier, Nieuwerkerk, Holland; M. Debaerdemaeker, Everghem, Belgium (3); DeCoster Bros., Melle, Belgium; Achille de Coster, Melle, Belgium (2); Arthur de Meyer, Mont St. Amand, Ghent, Belgium (2); August de Vreese, Loochristy, Belgium (4); Guldemond & Son, Lisse, Holland; K. J. Kuyk, Ltd., Ghent, Belgium (4); Van Dillewyn & Thiel, Meirelbeke, Belgium (7); Van Gelderen & Co., Loochristy, Belgium (2); A. Van Schoote, Ghent, Belgium.

Pseudomonas tumifaciens Crown Gall.

On Pear. Franco-American Seedling Co., Ussy, France.

On Lilac. F. Delaunay, Angers, France.

On Rose. F. Delaunay, Angers, France; W. Fromow & Sons, Windlesham, Surrey, England; Vincent Lebreton's Nursery, La Pyramide-Trelaze, France.

Acremoniella atra (a saphrophyte) on Rhododendron. Hugo T. Hooftman, Boskoop, Holland.

Macrosporium sp. (a saphrophyte) on Rhododendron. Hugo T. Hooftman, Boskoop, Holland.

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* W. D. Pierce. A Manual of Dangerous Insects Likely to be Introduced in the United States through Importations. U. S. Dept. of Agr. p. 106, 1917.

Pestalozzia guepini on Rhododendron.
Harry Koolbergen, Boskoop, Holland; Schaum & Van Tol, Boskoop, Holland.

Phyllosticta sp. on Rhododendron. Harry Koolbergen, Boskoop, Holland.

Glomerella cingulata on Palm. K. J. Kuyk, Ltd., Ghent, Belgium (2).

Ascomycete on Oak, Immature. Franco-American Seedling Co., Angers, France.

Insects.

Scale, Oyster Shell, on *Buxus*.
Jac. Smits & Co., Naarden, Holland; J. Verkade & Sons, Boskoop, Holland.

Emphytus cinctus on Manetti stock.
E. Bruzeau, Orleans, France; F. Delaunay, Angers, France; Franco-American Seedling Co., Angers, France; Franco-American Seedling Co., Ussy, France (2); Vincent Lebreton's Nursery, La Pyramide-Trelaze, France.

Aleyrodes Sp. on Azalea. M. Debaerdemaeker, Everghem, Belgium.

Aphis, Woolly, on Apple Roots. Franco-American Seedling Co., Ussy, France.

Malacosoma neustria, Egg mass. K. Rosbergen & Son, Boskoop, Holland.

Acronycta rumicis. F. Delaunay, Angers, France.

Acronycta rumicis. Cocoons. Vincent Lebreton's Nursery, La Pyramide-Trelaze, France.

Empty Dipterous Pupae on Azaleas. W. C. Hage & Co., Boskoop, Holland.

Empty Sawfly Cocoon. M. Debaerdemaeker, Everghem, Belgium.

Lepidopterous larva in packing material. J. Blaauw & Co., Boskoop, Holland.

Leaf Miner, Work in Holly. Jac. Smits & Co., Naarden, Holland.

INSPECTION OF APIARIES.

This work has been done in about the same manner as in former years, Mr. H. W. Coley of Westport covering Fairfield, New Haven, Middlesex and New London counties, and Mr. A. W. Yates of Hartford covering Litchfield, Hartford, Tolland and Windham Counties. Each inspector has been paid by the day and expenses for the time worked, from the appropriation made by the legislature for this purpose.

In 1917, 473 apiaries were inspected as against 467 in 1916, and though nearly all expenses have increased, the costs per apiary and per colony are slightly less than last year. Eighty-four towns were visited as against 96 last year. In 1917 apiaries were inspected in the following 18 towns where no inspections were made in 1916: Branford. North Branford. Durham.

Middletown, Portland, Kent, New Hartford, Plymouth, Roxbury, Thomaston, Watertown, Woodbury, Burlington, Canton, New Britain, Newington, Sterling and Woodstock.

European foul brood was found in each county in the state and in the following 37 towns: Bethel, Fairfield, Huntington, New Canaan, Norwalk, Ridgefield, Stamford, Weston, Westport, Ansonia, Madison, Middlebury, Naugatuck, Waterbury, Wolcott, Durham, Lisbon, Montville, New London, Norwich, Waterford, New Milford, Plymouth, Bloomfield, Bristol, East Windsor, Farmington, Manchester, New Britain, Plainville, Southington, Coventry, Plainfield, Pomfret, Putnam, Sterling and Windham. The percentage of apiaries and colonies infested was considerably lower than in 1916. American foul brood was found only in the town of Old Lyme in New London County. Of the 473 apiaries containing 4,506 colonies examined, 90 apiaries containing 241 colonies, or about 19 per cent., were found diseased.

The statistics of the apiaries inspected in each of the 84 towns in each of the eight counties may be found in the following tables, the summary occurring on page 245:

APIARIES INSPECTED, 1917.

	No. Apiaries			No. Colonies	
	Inspected	Diseased*	Quarantined	Inspected	Diseased*
FAIRFIELD COUNTY.					
Bethel	5	1	0	29	2
Bridgeport	1	0	0	5	0
Danbury	1	0	0	6	0
Darien	2	0	0	59	0
Easton	3	0	0	105	0
Fairfield	8	2	0	160	2
Greenwich	5	0	0	44	0
Huntington	4	2	1	99	3
New Canaan	3	1	0	35	6
Norwalk	7	1	0	60	1
Redding	6	0	0	51	0
Ridgefield	3	1	0	16	1
Stamford	14	2§	0	164	2§
Stratford	4	0	0	113	0
Trumbull	1	0	0	68	0
Weston	5	1	0	30	1
Westport	8	1	0	97	1
Wilton	9	0	0	164	0
	89	12	1	1305	19

* European foul brood unless otherwise indicated.

§ One with European foul brood and one with sacbrood.

New Haven County.					
Ansonia	1	1	0	14	1
Beacon Falls	1	0	0	12	0
Branford	1	0	0	4	0
Cheshire	8	1‡	0	79	2‡
Derby	5	1‡	0	89	1‡
Guilford	2	0	0	9	0
Hamden	2	0	0	13	0
Madison	3	1	0	46	4
Meriden	15	2‡	0	141	3‡
Middlebury	1	1	0	40	6
Milford	5	0	0	58	0
Naugatuck	6	3	0	42	11
North Branford	1	0	0	5	0
North Haven	4	0	0	104	0
Prospect	10	0	0	98	0
Seymour	1	0	0	18	0
Waterbury	10	5	5	58	32
Wolcott	1	1	0	9	3
	77	16	5	839	63
Middlesex County.					
Durham	2	1	0	71	10
Middletown	2	2¶	0	14	5¶
Portland	1	0	0	52	0
	5	3	0	137	15
New London County.					
Lisbon	2	1	0	5	1
Montville	9	4	0	52	6
New London	1	1	0	14	4
Norwich	7	3	0	164	3
Old Lyme	2	2†	0	57	8†
Waterford	2	1	1	63	21
	23	12	1	355	43
Litchfield County.					
Kent	5	0	0	63	0
New Hartford	1	0	0	32	0
New Milford	18	5	0	90	12
Plymouth	3	1	0	20	1
Roxbury	1	0	0	13	0
Thomaston	14	0	0	43	0
Watertown	7	0	0	63	0
Woodbury	1	0	0	27	0
	50	6	0	351	13

† American foul brood.
‡ Sacbrood.
¶ Bee paralysis.

HARTFORD COUNTY.					
Berlin	16	0	0	104	0
Bloomfield	11	3	0	207	6
Bristol	7	3	0	55	4
Burlington	4	0	0	26	0
Canton	7	0	0	21	0
East Hartford	3	0	0	42	0
East Windsor	16	3	0	113	13
Farmington	27	8	0	119	18
Glastonbury	17	0	0	90	0
Hartford	4	0	0	18	0
Manchester	13	8‖	0	93	12‖
New Britain	13	2	0	116	12
Newington	1	0	0	2	0
Plainville	7	2	2	28	5
Southington	5	2	0	33	4
South Windsor	3	0	0	20	0
West Hartford	2	0	0	26	0
	156	31	2	1113	74
TOLLAND COUNTY.					
Andover	2	0	0	7	0
Bolton	2	0	0	4	0
Coventry	6	1	0	50	1
Ellington	10	0	0	60	0
Mansfield	4	0	0	50	0
Vernon	4	0	0	57	0
	28	1	0	228	1
WINDHAM COUNTY.					
Brooklyn	3	0	0	20	0
Killingly	4	0	0	21	0
Plainfield	5	1	0	19	1
Pomfret	9	1	0	47	1
Putnam	5	1	0	13	1
Sterling	15	4	0	15	4
Windham	3	2	0	16	6
Woodstock	1	0	0	27	0
	45	9	0	178	13

SUMMARY OF APIARY INSPECTION.

County	No. Towns	No. Apiaries		No. Colonies	
		Inspected	Diseased	Inspected	Diseased
Fairfield	18	89	12	1,305	19
New Haven	18	77	16	839	63
Middlesex	3	5	3	137	15
New London	6	23	12	355	43
Litchfield	8	50	6	351	13

‖ Two with sacbrood; others European foul brood.

SUMMARY OF APIARY INSPECTION—*Continued.*

County	No. Towns	No. Apiaries Inspected	No. Apiaries Diseased	No. Colonies Inspected	No. Colonies Diseased
Hartford	17	156	31	1,113	74
Tolland	6	28	1	228	1
Windham	8	45	9	178	13
	84	473	90	4,506	241

	Apiaries	Colonies
Number inspected	473	4506
Infested European foul brood	79	219
Per cent. infested	16.7	4.86
Infested American foul brood	2	8
Per cent. infested	.42	.17
Pickled or sacbrood	7	9
Bee paralysis	2	5
Average number of colonies per apiary		9.52
Cost of inspection		$749.51
Average cost per apiary		1.58
Average cost per colony		.166

European foul brood was reported by Dr. Phillips from Wethersfield and Thompson.

SUPPRESSION WORK AGAINST THE GIPSY AND BROWN-TAIL MOTHS.

By W. E. Britton and Irving W. Davis.

The work against these two pests has been conducted as in preceding years. Mr. Davis has had supervision of the field work under the State Entomologist, and since June 1, 1917, has been assisted by Mr. John T. Ashworth, who has had much experience in this work, being formerly employed by the Gipsy Moth Commission of Massachusetts, and more recently by the Bureau of Entomology of the U. S. Department of Agriculture.

The scouts and other employees necessary have been hired as needed. Some of the scouts have worked for us for several seasons, and have also been employed by the Federal Bureau of Entomology. Others have taken up the work more recently and have received their training by working with the other men in the scouting crews. The force has been impaired, and the work interrupted by men accepting other positions or entering the military service of their country. It is very difficult at present to obtain any kind of help, and much more so the character and type of men who develop into good scouts.

In all of this work the most cordial co-operation has existed between this office and the Federal Bureau of Entomology, and we wish especially to express our thanks to Messrs. A. F. Burgess and L. H. Worthley, who have been in charge of the work for the Bureau.

For the control of the brown-tail moth we have continued clipping off and destroying the winter nests; for suppressing the gipsy moth, the work has consisted of scouting and creosoting egg-clusters, spraying badly infested areas, and banding and destroying caterpillars in and around the colonies or infestations.

New Equipment.

But little new equipment was purchased during the past year. The Ford touring car was turned in toward a new one in the first part of the spring and this has been used by Mr. Ashworth in his work. It is not proving as good as the older model. A four-cylinder Buick touring car was also purchased and has been used by Mr. Davis. As the territory grows, more money and time are saved by the use of automobiles, for many of the towns, such as Ashford and Voluntown, are miles from a railroad.

Employees Who Have Entered Military Service.

The following men have enlisted in the Army or Navy:

Sergt. George D. Stone, Battery D, 56th Mobile Artillery.
Adolph D. Jarvais, Battery D, 56th Mobile Artillery.
William Lord, U. S. Naval Reserve.
George Benoit, Medical Corps.
Clifford A. Ladd, U. S. Navy.
W. Floyd Logee, U. S. Navy.
Charles A. Burdick, 174th Aero Squadron.
James A. Knight, Depot Brigade, Camp Devens.

Brown-Tail Moth Work.

Though this insect now covers the eastern half of the State, it has not spread appreciably during the last two years. In fact, it is difficult to find webs in most of the area supposed to be infested. Last season the webs were so scarce, even in towns which had formerly been heavily infested, that it was not thought necessary to notify these towns to remove and destroy the webs

as was done in 1916. Some scouting was done, however. Men were sent to examine the towns just west of the quarantined area, but no new towns were found infested. Small colonies were located within the quarantined area at New London and Stonington and the webs were removed and destroyed. A few webs were gathered in Canterbury, Bozrah and Preston for Mr. Burgess to use in his parasite work, but even here they were so scarce that the desired number could not be obtained.

Our men were on the watch for adults around lights in various cities and villages in July, but none were observed.

Gipsy Moth Work.

The gipsy moth situation presents an entirely different aspect, however, as there were a large number of single egg-cluster infestations ("singles") throughout the towns in the northeastern corner of the State. This would indicate another but shorter windspread than that of 1913.

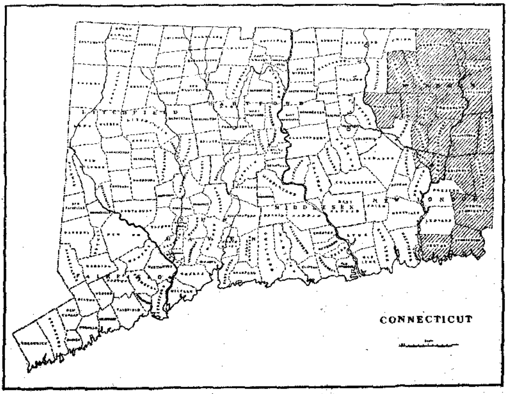

Figure 1. Map of Connecticut, shaded portion showing area now infested by the gipsy moth.

Further south and west an increase was also noted, as in Canterbury, Brooklyn, Hampton and Eastford, while Ashford showed a small decrease. Mansfield for the first time appears in the list of infested towns, two infestations being found near the eastern border of the town. This is the first time the gipsy moth has been taken in Tolland County. The area now infested is shown in figure 1.

Since our funds were limited and some of the towns had shown but few if any infestations in the past few years, it was thought best to scout only restricted portions of certain towns, as in the case of Sterling, Plainfield, Griswold, North Stonington, Stonington, etc. Three of the towns; namely, Sprague, Lisbon and Groton, were not scouted at all. We have planned to scout the entire infested area this coming winter.

The spraying was done with the horse-drawn power sprayer owned by the State and a power-truck sprayer which was lent to us by the Government. The former was used in Thompson, Putnam and Killingly where the infestations were the heaviest and near together. The Government sprayer was used in towns where the infestations were scattering and we were thus able to spray colonies in North Stonington, Canterbury, Hampton and Eastford. Altogether 91 separate infestations were sprayed.

With so many single infestations, it was impossible to band trees near all of them, and therefore only the larger colonies were thus treated. Every effort was made to visit all of the infested localities during the caterpillar season, and in this manner over 37,000 of the gipsy moth larvae were killed, besides those caught in the bands or poisoned by the spraying.

The food plants of the gipsy moth are very numerous but those most favored are apple, oak, willow and alder, while such trees as ash and the evergreens are seldom attacked. In Connecticut the woodland in the infested area consists largely of the various species of oak, with but few evergreens, and this section therefore offers an excellent chance for the spread of this pest.

Parasites.

There are several native insects and some birds that feed on the gipsy moth, but these are not able to control the pest. In 1905 the United States Department of Agriculture introduced from Europe and Japan a number of parasites, some of which

have become well established in this country. The most important of these are the Calosoma beetle (*Calosoma sycophanta* Linn), a tachinid fly (*Compsilura concinnata* Meig.), and several small wasp-like insects (*Apanteles lacteicolor* Vier., *Schedius kuvanae* How., *Anastatus bifasciatus* Fonsc.). All of these mentioned have been colonized in Connecticut with the exception of *Schedius*, an egg parasite. These are, of course, very scarce in this State at the present time, and until they become more plentiful the artificial methods of control will have to be employed.

Some gipsy moth pupae collected in Canterbury in November, 1917, were infested with a white mold or fungus, which has been identified by Mr. A. T. Speare, Bureau of Entomology, as *Isaria farinosa* (Dicks) Fr., a species previously recorded from Massachusetts on gipsy moth pupae.

Present Status of Parasite Work in Connecticut.

The following tabulated information regarding parasites introduced into, and recovered from Connecticut, has kindly been furnished by Mr. A. F. Burgess:

Compsilura concinnata Meig.

Colonized:	1912	1913	1914	1916	1917
	Putnam	Hartford	Plainfield Mansfield Stonington	Suffield Stafford Colchester Norwich Old Lyme	Scotland Hampton
Recovered:			1915	1916	1917
			Woodstock	Stonington	Putnam Plainfield No. Stonington

Zygobothria nidicola Towns.

This species has never been colonized in Connecticut, but in 1917 was recovered from Canterbury and Waterford.

Apanteles lacteicolor Vier.

	1912	1913	1915	1916	1917
Colonized:	Putnam	Suffield	Manchester	East Lyme	Montville
		Hartford	Chester	Canterbury	Groton
		Mansfield	Lebanon		
		Norwich			
		Stonington			
		Griswold			
		Plainfield			
		Killingly			
		Hampton			

	1913	1914	1915	1916	1917
Recovered:	Thompson	Waterford	Stonington	Killingly	Canterbury
	Woodstock	Hartford	Lebanon	Brooklyn	
	Pomfret		Suffield	East Hartford	
	Stafford			Wethersfield	
	Somers				

Meteorus versicolor Wesm.

	1916	1917
Colonized:	Colchester	Lyme
	Waterford	
	Ledyard	

	1914*	1916
Recovered:	Hartford	Woodstock
		Thompson
		Killingly
		Brooklyn

Anastatus bifasciatus Fonsc.

Colonized: 1917

Town	Number of Colonies
Thompson	21
Woodstock	5
Putnam	3
Killingly	6
Pomfret	3
Eastford	2
Brooklyn	3
Hampton	5
Chaplin	1
Mansfield	1
Canterbury	1
Total	51

*Note: It is probable that many of the earlier colonies of *A. lacteicolor* also contained a few cocoons of *M. versicolor*.

Each of these colonies contained 1,000 parasites, making a total of 51,000 parasites of this species liberated in Connecticut in 1917. Collections of gipsy moth eggs will be made in Connecticut this winter to determine the success of these colonies.

Calosoma sycophanta Linn.

Stonington:

On June 16, 1914, a colony containing 60 males and 50 females was liberated on Mr. E. P. Edwards' farm about one mile from depot, in an orchard almost defoliated by the tent caterpillar, *Malacosoma americana*, adjoining a wood lot where a gipsy moth egg-cluster had been found.

On the same date another colony, containing 60 males and 50 females, was liberated on York farm in the Anguilla district, about four miles from depot, in orchard infested with tent caterpillar, *Malacosoma americana*.

Up to January 1918, no recoveries have been made in the vicinity of these two Stonington colonies.

Thompson:

On July 6th, 1915, a colony containing 60 males and 50 females was liberated about 500 yards south of the Thompson railroad station.

On the same date a colony containing 60 males and 50 females was liberated in oak woodland on east side of electric railway, one mile south of Wilsonville, on property of the Grosvenordale Company.

On July 7, 1914, Mr. W. F. Kelly of the Federal Bureau of Entomology, while scouting woodland in Thompson, recovered and sent to the laboratory one male adult.

On September 12, 1916 the site and surroundings of both colonies mentioned above were scouted for larval molt skins or eaten pupae, but none were found.

Killingly:

On July 17, 1917, a colony containing 40 males and 50 females was liberated on property of C. O. Chase, near Putnam Heights, where a gipsy moth colony was found in 1916.

Mr. Harry L. Johnson of South Meriden took a specimen of this species near his home on May 24, 1915. So far as known the insect had not been planted within 40 miles of this locality.

Details of Gipsy Moth Work by Towns.

The following detailed account of the work in each town was prepared by Mr. Davis:

Thompson—518 infestations—2,837 egg-clusters.

Thompson continues to be one of the most thickly infested towns in the State. During last season 518 infestations containing 2,837 egg-clusters were located within its limits, and while there were a large number of infestations that contained only a single egg-cluster each, there were several that varied in size from 75 to 250 egg-clusters. The entire town is infested, but the eastern portion of the town is the worst, the infestations being more and more scattered as the work is carried west.

A year ago it was noted that a large number of infestations were found on the road leading from Brandy Hill to Webster, Mass. This road runs along the side of a ridge which in that section extends almost north and south, and from the top of this ridge eastward to the Rhode Island line the country was generally infested. Outside of this area large colonies which might be noted were those on the State road above Wilsonville, in a large oak near Quinebaug, and on the golf links near the Putnam town line.

The summer work was about the same as that done in previous years, namely, banding the trees around the infestation with either Tanglefoot or Raupenleim, the men attending to these bands every few days during the larval season and destroying all caterpillars which could be found there. The power sprayer was also used again and 49 of the largest colonies were sprayed with a mixture of arsenate of lead.

Scouts have already been doing some woodland scouting in this town, and several colonies have been located although but few singles have been found.

Woodstock—180 infestations—714 egg-clusters.

This town was scouted by men employed by the U. S. Department of Agriculture, as were many of the towns in the State, and the result was the finding of 180 infestations, only 30 of which contained more than a single egg-cluster.

A large number of singles were found in the vicinity of South Woodstock, but the larger infestations seemed to be in a line running from the northeast to the southwest corner of the town.

The largest colony was in the northeastern part of the town on land owned by Mr. A. T. Avery, where 130 egg-clusters were found on some pasture oaks.

The heaviest infested areas were banded during the summer and about 2,500 caterpillars were killed. The power sprayer was used in this town to spray seven of the worst infestations.

Putnam—163 infestations—488 egg-clusters.

Putnam is one of the towns in the northeastern portion of the State which have been heavily infested since the scouting was first started in 1913, and during the winter of 1916–17 one hundred and sixty-three infestations containing four hundred and eighty-eight egg-clusters were found.

As Putnam is a rather small town containing about twenty square miles, the number of infestations found shows Putnam to be about as thickly infested as Thompson, which lies to the north of it. A large number of singles were also located in this town, but most of the larger colonies were along the northern border. One exception to this was a group of infestations in some oak woods near the Killingly line. This woodland lies partly in Putnam and partly in Killingly and colonies of the gipsy-moth were found in these woods in both towns.

During the early part of the summer fourteen of the largest infestations were sprayed and in the course of the tanglefoot work which closed the last of July, over 9,000 caterpillars were destroyed besides those which were killed by spraying.

Pomfret—59 infestations—309 egg-clusters.

During the late summer and early fall of the year 1916, a crew of men worked in the western part of Pomfret at woodland scouting, but there were not many colonies located. In the winter the roadside scouting showed 59 infestations well scattered throughout the town. Only twelve of these colonies, however, contained more than one egg-cluster each, and the majority of these were in the woodland.

The largest of these infestations were banded early in the spring and the work of patrolling the banded areas was carried on until the end of July. During the spraying season, the Federal sprayer was used in Pomfret, and three of the worst infestations were sprayed.

Eastford—27 infestations—251 egg-clusters.

Just to the south-west of Eastford village, there is a large section of woodland with but a few farms scattered through it. In this area the most of the infestations found in the town of Eastford were located.

Although the most of the colonies were in the section noted, the largest infestation in Eastford, which contained 106 egg-clusters, was found about a mile northwest of the village near the Woodstock line.

Three of these infestations, including the last one mentioned, showed several larvae in the early part of the season and these were sprayed with arsenate of lead during the latter part of June. The banded trees were inspected as in previous years and continued until the latter part of July, when the season closed.

Ashford—2 infestations—3 egg-clusters.

In Ashford, only two infestations of the gipsy-moth were found last winter, and these were both near the eastern side of the town. They were both banded and patrolled but during the summer work only one gipsy-moth caterpillar was found.

Killingly—182 infestations—622 egg-clusters.

This is a rather large town, covering an area of about fifty-two square miles and extending for nine miles north and south along the Rhode Island line. In the northern portion of Killingly the infestations were rather heavy, both as regards colonies and single egg-cluster infestations. Toward the south part of the town there were no large colonies, and there was a marked decrease in the number of singles found.

It was impossible to band the trees around all of the single infestations, so only the larger colonies were thus treated, although all of the infested localities were visited during the patrolling work in the summer. Early in the month of July three of the worst colonies were sprayed.

Brooklyn—41 infestations—305 egg-clusters.

The eastern portion of the town contained a majority of the infestations, but these were practically all single egg-clusters. The largest colony in Brooklyn was located just to the west of Tatnic Hill, and here one hundred and ninety-seven egg-clusters were creosoted. Smaller colonies were found on Barrett Hill

in the northern part of the town, and in a maple swamp a little west of Church Street. The larger colonies were banded with tanglefoot and during the patrolling work over 5,000 caterpillars were destroyed. The season closed the latter part of July.

Hampton—30 infestations—248 egg-clusters.

With the exception of a group of infestations in the northern part of the town near the Pomfret line, the gipsy moth colonies were well scattered throughout the town. In this group were several colonies, but the two largest infestations were found in other parts of the town, one being in the west portion near Chaplin, while the other was in the east side about a half a mile from the Brooklyn line.

At one of the colonies in the group already noted, a large number of caterpillars were found in the early part of the summer, but prompt work caused a decided decrease in the number of larvae and it is believed that this colony has been destroyed. The spraying of a colony has proven to be a very effective means of combating this pest, and seven of the largest colonies in Hampton were thus treated during the last season.

Chaplin—4 infestations—34 egg-clusters.

The result of the scouting in the town of Chaplin last winter was the finding of four gipsy-moth colonies, the largest of which was a woodland colony in the northeastern section of the town on land owned by Mr. W. H. Phillips.

This infestation, together with the others in this town, was carefully watched until the end of the larval season, our work closing the latter part of July.

Mansfield—2 infestations—76 egg-clusters.

The town of Mansfield was found to be infested with the gipsy-moth in the year 1916 for the first time. Two infestations were discovered by scouting, and both were near the Chaplin line. One was a single while the other was a woodland colony of seventy-five egg-clusters. At the former infestation, no larvae were found during the summer work, but at the latter several were taken and the nearby foliage was sprayed with arsenate of lead.

Sterling—7 infestations—7 egg-clusters.

Since there were no infestations of the gipsy-moth found in Sterling in the winter of 1915–16, it was not thoroughly scouted

during the past winter. The work which was done in this town revealed seven infestations of one egg-cluster each.

Plainfield—1 infestation—29 egg-clusters.

There was only one infestation found in the scouting which was done in the town of Plainfield during the last winter. This colony contained twenty-nine egg-clusters, and was located a little north of the colony found the previous year. The colony did not appear very serious, for while several larvae were taken in the earlier part of the summer, only a few were taken after the first of July.

Canterbury—27 infestations—81 egg-clusters.

This town in the past few years has had many colonies located in the northern portion, and again this last season the majority of the colonies were located there. Other colonies were scattered throughout the town, but the only two important colonies were in this group. Both of these appeared serious early in the month of June, and as was the case in the other infested towns, the patrolling work was kept up until the end of July.

Scotland—4 infestations—9 egg-clusters.

The four infestations in the town of Scotland contained in all but nine egg-clusters, and although these were attended during the larval season, only eleven caterpillars were found, and those during the early part of the season.

Voluntown—4 infestations—4 egg-clusters.

Only portions of Voluntown were scouted during the winter of 1916–17 and but four single infestations were found.

Griswold—1 infestation—6 egg-clusters.

One colony containing six egg-clusters was brought to light by the scouting which was done in Griswold the last season. The trees around this colony were banded with raupenleim, and during the early part of the season a number of caterpillars were found, but none were taken after the middle of July.

Lisbon—Sprague.

No scouting was done in these two towns last winter. They have never had many infestations, and during the winter of 1915–16 nothing was found withing their limits, so it was decided to use the money elsewhere this year.

North Stonington—3 infestations—147 egg-clusters.

In the past two years the infestations found in this town have all been in one section so that this past season only that section was scouted. Three infestations were found and these contained 147 egg-clusters, all but six of which were in one colony. This colony was on land owned by Mr. William Rathburn and was situated in the southeastern part of the town. As this colony was of a serious nature it was sprayed early in the season, as was also one of the other colonies where several caterpillars were found.

Stonington—2 infestations—12 egg-clusters.

The section of Stonington which was scouted last winter showed only two infestations of twelve egg-clusters, but neither of these were of a serious nature.

Groton—No scouting was done in this town last year.

STATISTICS OF INFESTATIONS.

The following table summarizes the work by towns:

Towns	No. of Infestations	No. of Egg-clusters Destroyed	No. of Bands Applied	No. of Infestations Sprayed	No. of Larvae Destroyed
Thompson	518	2,837	8,517	49	12,945
Woodstock	180	714	2,171	7	2,620
Putnam	163	488	1,786	14	9,626
Pomfret	59	309	991	3	92
Eastford	27	251	1,079	3	904
Ashford	2	3	34	0	1
Killingly	182	622	1,410	3	1,841
Brooklyn	41	305	794	0	5,449
Hampton	30	248	133	7	1,413
Chaplin	4	34	229	0	741
Mansfield	2	76	11	1	45
Sterling	7	7	0	0	0
Plainfield	1	29	37	0	212
Canterbury	27	81	228	2	1,405
Scotland	4	9	118	0	11
Voluntown	4	4	0	0	0
Griswold	1	6	24	0	95
Lisbon	0	0	0	0	0
Sprague	0	0	0	0	0
North Stonington	3	147	128	2	400
Stonington	2	12	0	0	0
Groton	0	0	0	0	0
Total	1,257	6,182	17,690	91	37,800

EXPERIMENTS IN SPRAYING APPLE ORCHARDS TO CONTROL APHIDS AND FALSE RED-BUG.

By W. E. Britton and M. P. Zappe.

For several years there has been much damage to the fruit crops in certain apple orchards from the attacks of red bugs and aphids. The false apple red bug, *Lygidea mendax* Reut., is responsible for the red bug injury (See Plate III) as the true red bug, *Heterocordylus malinus* Reut. has not yet been found in Connecticut. The false or lined red bug was first observed in Greenwich in the southwest corner of the State and it has caused injury there each year since, and has gradually extended northward and eastward. We have no evidence to show that it occurs throughout the State, though probably such is the case. Certainly, orchards here and there are not injured by it and it seems to be more prevalent in the southwestern portion than elsewhere in the State.

The rosy apple aphis, *Aphis sorbi* Kalt., is the species chiefly responsible for the aphid injury to the fruit. This species attacks the leaves and young fruit of the fruit clusters, dwarfing and deforming the apples, while the green apple aphis, *A. pomi.* Degeer, occurs more particularly on the leaves of water sprouts and terminal twigs. During 1917 the rosy aphis was also on the foliage of the terminal branches, but it is usually found in more shaded situations inside the crown or head of the tree.

In order to obtain data regarding the effect of nicotine sprays on these insects, some tests were conducted in the orchards of S. A. Smith & Son, Clintonville, and Frank N. Platt, Milford. The details of the treatment and results obtained are given with comments under the headings below. The fruit was not thinned in either orchard. All fruit was examined at harvest and scored as regards all insect injuries. This required a careful inspection of 98,652 apples.

Smith's Orchard, Clintonville.

The orchard consists of 6 rows of trees running nearly north and south with 11 trees in a row. The rows were numbered 1–6, beginning on the east side. Beginning at the north end the trees were numbered 1–11; the first five trees in each row are

Baldwins, the next tree is an Ohio Nonpareil, and the other five are Greenings, except for a tree here and there which has been top-grafted to Opalescent.

On May 21, four rows of trees in this orchard were sprayed with the following mixture:

Black leaf 40	1 pint
Lead arsenate (powder)	2½ lbs.
Commercial lime-sulphur	2 gal.
Water	100 gal.

Rows 2 and 5 were left as checks and were not treated with nicotine solution but were sprayed later with lead arsenate and lime-sulphur. A few trees were not sprayed at this time because the blossoms were nearly open and bees were working in them. These exceptions were tree No. 6 in each row (all Ohio Nonpareil) and tree No. 9 in row I, and trees Nos. 9 and 10 in row III (Greenings).

The spraying outfit consisted of a kerosene tractor used to work the pump and to haul the 100-gallon spray tank. A small gasoline engine mounted on the spray-tank was used to agitate the mixture. This outfit is shown on Plate II, b. The spray was applied from two lines of hose, throwing in opposite directions. One man sprayed up through the tree and the other down from the top. The pressure used was from 175 to 200 lbs. The weather conditions were ideal for spraying.

The second spraying with nicotine solution was given only to rows I and VI on June 4. The rest of the orchard was sprayed with lead arsenate and lime-sulphur but no Black Leaf 40 was used.

The fruit was picked and scored during the week of September 24–29.

The red bug injury was not serious in this orchard and it was difficult to find specimens. Nevertheless, the insect was present and was hatched from twigs cut early in the spring. The injury was slightly reduced by the treatment.

Aphids were a much more serious menace, however. Certain trees showed a large proportion of aphis apples at harvest. This injury was greatest on one of the check rows and was least where two treatments were given. A summary of the results appears in the following table:

SUMMARY OF RESULTS OF SPRAYING TREATMENTS.

Row	Good Per Cent.	Red Bug Per Cent.	Aphis Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Maggot Per Cent.	Other Chewing Insects Per Cent.	Total Number of Apples Per Row
1	74	01	19	02	004	01	02	7,809**
2	61	02	31	02	005	002	03	9,183‡
3	63	009	32	02	001	002	02	8,388*
4	71	006	23	02	01	003	02	14,947*
5	54	02	35	04	02	001	03	11,696‡
6	80	002	10	04	02	008	02	11,552**

PLATT'S ORCHARD, MILFORD.

The section of orchard used in these tests has 8 rows of trees running nearly east and west. The four rows on the north side are Baldwin and the other four rows are Greening, Smokehouse, White and King. The rows were lettered A to H from south to north, and the trees in each row numbered 1 to 12 from west to east. The two rows in the center of the orchard were not sprayed with nicotine but left for checks. This orchard was given only one spraying and that on the afternoons of June 12, 13, 14 and 15, after the petals had fallen. The spray outfit was a common horizontal cylinder hand pump, mounted on a 100-gallon tank. Two lines of hose were used, one man spraying from a tower on the tank and the other from the ground. The pressure was not sufficient for the best results, as the trees were compact and the foliage was heavy. With this pressure the spray could not be driven through the crown of the tree. The fruit was picked and scored on August 31, October 4, 8, and 18. The crop was very light—especially the Baldwins—many trees having no fruit at all.

There was much red bug injury in this orchard. Some had already been done before the nicotine was applied. There was also considerable injury from aphis, which would in part have been prevented by an earlier application. The spray mixture was substantially the same as used in the Smith orchard. See page 260.

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* One treatment.
‡ Check.
** Two treatments.

A summary of the results are given in the following table:

SUMMARY OF RESULTS OF SPRAYING TREATMENT.

Row	Good Per Cent.	Red Bug Per Cent.	Aphis Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Maggot Per Cent.	Other Chewing Insects Per Cent.	Total Number of Apples Per Row
A	53	12	27	01	002	02	03	10,032
B	47	20	31	004	002	002	02	6,886
C	48	28	21	007	004	004	03	6,584
D*	37	44	15	007	002	001	03	7,018
E*	30	39	26	005	003	0	04	1,873
F	66	13	13	01	0	0	09	573
G	60	07	21	02	002	0	09	1,576
H	56	0	37	02	0	0	04	535

We believe that the spraying should be done earlier next year. The branches should be thinned out to let in more light and air. More effective spraying can unquestionably be done with larger pump or power outfit, capable of maintaining a pressure of from 200 to 300 lbs. per square inch.

We hope to continue the experiments another year.

THE STRIPED CUCUMBER BEETLE.

Diabrotica vittata Fabr.

Order Coleoptera; Family Chrysomelidae.

By QUINCY S. LOWRY.

For the past few years Connecticut gardeners have had considerable difficulty in growing cucumbers and squashes, due to the fact that the striped cucumber beetle has been so destructive. Consequently, in 1916 and again in 1917, one-half acre of ground was set aside at the Station farm at Mt. Carmel to carry on field experiments for controlling this and other pests of the cucumber and squash.

These small, yellow and blacked striped beetles, shown on plate IV, b, and in figure 2, are voracious feeders, not only on cucumbers but other cucurbitaceous plants, often causing the entire destruction of the first planting. In both 1916 and 1917 these beetles necessitated a complete second sowing of seed.

DISTRIBUTION AND HISTORY.

The striped cucumber beetle is especially abundant and destructive in the United States east of the Rocky Mountains and

* Rows D and E, checks.

is distinctly a native pest. As early as 1843 it was reported as an injurious insect, and in 1864 Dr. Fitch* published an article on the beetle in which he states that for more than twenty years he has had to protect his cucumber vines against the attack of these beetles.

In 1781 this beetle was described by Fabricius, in his Species of Insects, Vol. I, p. 148, under the name *Cistela melanocephala*, or the "Black-headed Cistela." A few years afterwards it was placed by him in the genus *Crioceris*, but as there was already another species having the same name he renamed it *vittata*, or "Striped Crioceris." Inasmuch as this beetle was not known at this time to be a pest outside of America, Gmelin gave it the name *Cryptocephalus americanus*, which was quite appropriate. Shortly after, Olivier determined the place of this insect to be in the genus *Galeruca*. Chevrolat, however, proposed a division of this genus, giving it the name *Diabrotica*, in which it has since remained.

Food Plants.

It is well known that this beetle feeds not only on the cucumber, squash and melon, but on all related *Cucurbitaceae*. It is frequently found feeding on the foliage of other vegetables, and the past season attacked the leaves of young peas and beans at the Station farm. Sirrine of New York, in 1899, reported that it feeds on the flowers of the apple, cherry, choke cherry and wild balsam apple. In 1916 a row of peanuts, *Arachis hypogoea* Linn., adjoining this field were found infested with these beetles. They are quite frequently found feeding on goldenrod and sunflower blossoms.

Injury.

These beetles feed during the whole season from late in the spring until October or later in the fall on cultivated or wild plants. The greatest amount of damage is caused by the adults just as the plants start out of the ground. The beetles attack the cotyledonous leaves, and in 1916 they had destroyed the entire crop before the majority of these leaves had appeared above ground. Although the greatest loss is caused at this time,

* 10th Report, Fitch's Noxious Insects of New York.

later in the season they feed on the stems of the vines and also on the flowers. This causes a weakening of the vines and to some extent prevents the setting of the fruit. The larvae feed on and tunnel in the main stems; (see Plate V); however, the damage caused by the larvae is not to be compared with that of the adult because after the stalks start to shoot out running vines they are generally vigorous enough to stand the attack from these insects. They prefer only the young and most tender parts of the plant and when the plants become woody the beetles cause no more damage except to the leaves and blossoms. It is, therefore, evident that the most damage is done when the plants are small, and the wilting of the vines, due to the work of the larvae, is not very great. The mining of the stems by the larvae has not very much immediate effect on the plants but this season there was an increased tendency of both cucumber and squash vines to develop certain forms of fungous diseases.

The loss incurred by disease due to the feeding of the larvae has been estimated at from ten per cent. to forty per cent. of the crop. Several cucumber vines this year, when from two to three feet long, became infested with a wilt, determined by the botanist of the Station to be the Fusarium wilt. Some of the more common diseases of cucumbers occurring in Connecticut are the downy mildew, *Pernoplasmopara cubensis* (B. & C.), Clint., and anthracnose, *Colletotrichum lagenarium*. This season there was comparatively little damage done to the fruit; nevertheless, the larvae work in the rinds of the fruit, causing a warty appearance. The feeding of the larvae also provides for the growth of rots and bacterial diseases. These beetles, besides being destructive to cucumbers, cause considerable damage to melon and squash, especially in market garden sections. They cause the most loss in sections where there is a scarcity of wild flowers. These beetles originally fed on the blossoms of such flowers as the goldenrod and wild species of the gourd. Although at the present time they do feed on some wild flower blossoms, they prefer to remain in vegetable gardens until the cold weather drives them to their hibernating quarters.

Life History.

ADULT. The beetles emerge from their hibernating quarters in May and June, although a few beetles may be found during

warm sunny days in April. The beetles appearing early are undoubtedly the ones that do not go into the ground to hibernate but find suitable quarters in farm buildings. The ones appearing early feed on a large variety of food plants until the squash and cucumber plants break through the ground. At this time they are ravenous feeders and usually feed a week or ten days before mating. The adults have a habit of hiding in cracks in the ground and cause considerable damage before one realizes that they are present in any great numbers. Some days, especially when it is cloudy, scarcely any beetles can be found in sight, but if the earth is disturbed a great many of them will fly about. They not only hide in the loose soil but also on the under side of the leaves. They soon begin to mate and the females shortly after begin to lay eggs. The tendency to pair is very strong and this often continues long after the egg-laying period.

EGG. The eggs are laid promiscuously (see plate IV, a), the female dropping them in crevices of the soil near the stems of the plants. They are also commonly found underneath the leaves; in fact, it appears that the female drops eggs anywhere she happens to be feeding or hiding. In the field the eggs are deposited singly. Sirrine reports that in all his field observations he had never found eggs deposited in clusters although females in confinement deposited a great many eggs in a few hours, a large proportion of these being laid in clusters. The number of eggs deposited varies from about thirty up to one hundred. The largest number ever observed deposited by a single female is one hundred and seventeen. From recent observations the female deposits all of her eggs in a single season. Some female beetles which have been kept in captivity have been known to lay eggs a second season. This was the case of a female of *Calosoma frigidum* Kirby, according to Mr. Burgess. The hatching period of the striped beetle eggs varies according to the temperature. Experiments have proved that in an average temperature of 74°F. the eggs hatch in eight or nine days.

LARVA. The larval stage is passed in the soil and may be found in the stems or on the fruit where it touches the earth. The larvae, however, can only mature in moist earth. When the larvae first hatch, unless they have moisture they will live but a short time. It requires about a month from the time the egg hatches until the larva becomes full grown. It then leaves the

plant and makes an oval, earthen cell in moist earth in which it pupates.

PUPA. The pupal stage is passed in from six days in warm weather to two weeks in colder weather. In this locality there is but one generation annually, although in Washington there are at least two, and possibly three generations in a single season.

DESCRIPTION.

ADULT. The general appearance of the striped beetle is shown on plate IV, b; it is a glossy, bright lemon-yellow, rather small beetle with a black head. The antennae are also black with the exception of the first three joints, which are a yellowish color. They are about two-thirds the length of the body. The thorax is not quite as broad as the wing covers. There are two indentations on the upper side of the thorax a little more than half way from its center. The wing covers are oval in outline and slightly convex. Each wing cover has nine furrows running lengthwise; in each of these furrows there is a row of small punctures. There are three black stripes on the wing covers, the middle one being on the suture. The wings are of a gray-brown color. The beetle measures about two-fifths of an inch in length (see plate IV, b), and is nearly half as wide as long.

EGG. The egg is of a light yellow or lemon-yellow color and is shown on plate IV, a. It is somewhat smaller than some of the other species, such as *Diabrotica 12-punctata*, and averages 6 mm. in length and about half as wide. It has the same markings as those of *Diabrotica longicornis* Say, figured by Forbes in the 12th Report on Insects of Illinois, page 18.

LARVA. The larva is a small, slender, soft "grub," dull-white, with a dark brown head and anal plate, the thoracic plate being light brown in color. It measures about one third of an inch in length, and is about one-tenth as thick. It has six thoracic legs and one anal proleg. It is covered with a few scattering hairs.

PUPA. The pupa is of a yellowish-white color. Its appearance is rather unique inasmuch as the antennae, legs, wing and wing covers are enclosed in separate sheaths, thus being free from the body.

in Adult, larva and pupa are shown in figure 2.

Parasites.

One of the most important natural enemies of the striped beetle is a tachnid fly, whose life cycle is passed within the adult beetle. This fly proves to be very destructive and undoubtedly helps greatly to keep this pest in check. It is known as *Celatoria diabroticae* Shimer.* Some of the ground beetles and certain species of ants feed on the larvae.

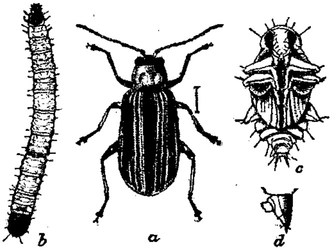

Figure 2. The striped cucumber beetle: *a*, adult beetle: *b*, larva; *c*, pupa; *d*, side view of anal segment. All greatly enlarged. (After Chittenden, Circular 31, Bureau of Entomology, U. S. Department of Agriculture.)

Field Tests in 1917.

The half acre used in this experiment was planted to twelve rows of cucumbers and fourteen rows of squashes. The treatments given were as follows:**

CUCUMBERS.

Rows 1, 2 and 3.	Land plaster or gypsum.
" 4 " 5.	Air slaked lime.
" 6 " 7.	Lead arsenate (Spray).
" 8 " 9.	" " (Dry).
" 10 " 11.	Fine coal ashes.
" 12.	Protectors.

* Chittenden, F. H. Insects injurious to Vegetables, Fig. 105, p. 157.

** The beetles were so abundant it was useless to leave any check rows. Consequently it was thought best to use the ground to the best advantage and try to protect all the rows without leaving any for check rows.

SQUASHES.

Rows 1, 2 and 3.	Fine coal ashes.
" 4, 5 " 6.	Lead arsenate (Dry).
" 7 " 8.	Black Leaf 40 and lead arsenate.
" 9.	Protectors.
" 10.	Black Leaf 40 and soap.
" 11.	Lime sulphur.
" 12.	Black Leaf 40 and lime-sulphur.
" 13 and 14.	Land plaster or gypsum.

The varieties used were Long Green cucumbers and Hubbard squashes. On April 24, strawberry boxes were used to plant the seeds. Twenty-five boxes were planted with cucumber seeds, using ten seeds in each box. Also twenty-five boxes of squash seed were planted using six in each. These were put in a greenhouse. On the 12th of May, out of 150 squash seeds planted, only 40 squash plants lived and 38 cucumber plants out of 250 seeds planted. Consequently it was necessary to replant these boxes with seeds. On May 24th and 25th one row each of cucumber and squash plants were set in the field from those started in the greenhouses and protectors placed over them like those shown on plate IV, c. The rest of the field was planted with seeds. The cucumber plants were all badly sunburned and consequently were replanted on May 31st. On June 14th and 15th the above-mentioned treatments were applied to the remaining plants, which were few. It was necessary, therefore, to plant over nearly all squash and cucumbers on June 16th.

On July 3d, in order to have a good stand several more seeds were planted in the squash plot, none, however, were planted in the cucumber plot. The protectors that were used on the cucumbers and squash were removed on this date, the plants filling the space under them.

Another application of remedies was made on July 5th, this being the last treatment given to the cucumbers.

Methods of Control.

Under ordinary conditions a great majority of these beetles can be controlled by spraying or dusting with arsenical poisons

but when they are abundant it is a difficult matter. It is, therefore, necessary to use more than one method in order to satisfactorily control this pest. Cultural methods, repellents, preventatives, and insecticidal methods are commonly practiced, collectively, to obtain the best results.

CULTURAL PRACTICES.

Clean culture is an important factor in controlling this pest. When the crop has been harvested, all refuse, including all the old vines, should be removed from the field and burned. This will destroy a great many of the beetles that would otherwise hibernate, and therefore lessen the number of beetles to attack the plants the following spring.

Plowing. After the crop has been harvested and all refuse removed, harrowing the ground lightly will kill many adults that remain near the surface before hibernating. Plowing deeply in the spring will also kill many hibernating adults.

Trap crops. Beans and squashes have often been planted as trap crops, especially by market gardeners who grow quantities of melons. Young squash plants are a favorite food of these beetles and are preferred by them to the cucumber. If squashes are planted in the spring, a week or ten days before the cucumbers or melons, the beetles will feed on them before the cucumbers push out of the ground. Then poison the squashes with arsenate of lead. Squashes or beans can also be planted around the borders of the field late in the season in order that the new generation of beetles can have tender food on which to feed. Those of the new generation feed before hibernating and if this food is provided, just as soon as they begin feeding upon it the young plants can be sprayed or dusted with an arsenical poison. This will kill many of the beetles before they seek winter quarters.

Rotation of Crops. A field that has been infested by these beetles should not be planted with cucurbits for at least two years, neither on nor near the previously infested ground. Rotation of crops for two, and better, three years, will lessen the infestation.

Fertilizers. The use of quick-acting fertilizers will enable the plants to make a quick growth. This will help them, to some extent, to outgrow the attack of the beetles.

Time of planting, etc. It is advisable in the early spring to start the plants in a greenhouse or in frames. If this is done early enough so that the plants are of a fair size when set out in the field, they will be able to withstand the attack of the beetles. If this cannot be conveniently done, it is well to plant nearly twice as many seeds to a hill as are necessary. Later, if more plants survive the attack than are needed, it is an easy matter to thin out to the desired number. Some vegetable growers recommend several plantings to be made a few days apart. This will undoubtedly prove more or less satisfactory, but it has the tendency to produce a late crop. In Connecticut, at least, it is important to produce cucumbers just as early as possible, before the market has been flooded.

PROTECTIVE METHODS.

Protectors. For many years coverings of some sort have been used as a protection for the young plants against the adult beetles. There are many different kinds of coverings on the market and many home-made devices are used. In 1916 protectors were purchased from Joseph Breck & Sons, Boston, Mass., to be used in connection with our field tests. At that time the price was $1.50 per dozen. These protectors have been used for two seasons and are shown on plate IV, c. A majority of these can be used at least another season without many repairs. Serviceable protectors can be made at home by cutting a barrel hoop in two, crossing the halves, and tacking the ends to another hoop. This frame is then covered with mosquito netting like those purchased. The protectors have proved satisfactory, although if the cloth becomes broken the beetles can crawl through. Wire screening is more substantial but more expensive. If the frames are covered with wire screening they can be used from year to year.

REPELLENTS.

Tobacco, Naphthalene. Many repellents have been used from time to time but without any particular results. Tobacco dust has been tried in Connecticut without great success, although it has the advantage of acting as a fertilizer. Naphthalene balls and flakes have been scattered around each hill without success.

Fine Coal Ashes. Finely sifted coal ashes heavily dusted around the plants are more or less satisfactory in keeping the beetles away.

Air-Slaked Lime. Dusting with air-slaked lime is an old time remedy and will prove successful when the beetles are not very abundant.

Lime-Sulphur. Spraying with lime-sulphur has given better results than some of the above-mentioned materials. If used 1 to 50, it will not injure the foliage.

Land Plaster or Gypsum. In using dry materials it is essential that the whole plant be thoroughly dusted. This is especially the case in using land plaster. If the leaves are merely covered with dust it will have the tendency to drive the beetles to the under sides of the leaves or to the stems of the plants. Where dry materials are used, the stems of many plants have been badly chewed near the surface, and sometimes beneath the surface of the ground. It is also true that even when the plants are covered with dust the beetles often feed on them.

ARSENICAL POISONS.

Arsenate of Lead. Arsenate of lead has been more successful in Connecticut than other artificial measures. This can be used either as a spray or dusted on the plants. When used as a spray, 3 pounds to 50 gallons of water is sufficient. Arsenate of lead can also be used in combination with other materials, such as Black Leaf 40 and lime-sulphur.

Arsenate of Lime. This was applied in the form of a spray (1 oz. in 1 gallon of water) at the Station farm in 1917. As this poison injured the foliage where used at this strength, it cannot be recommended.

CONTACT POISONS.

Black Leaf 40. Black Leaf 40, a nicotine sulphate solution, has been used alone and in combination with lime-sulphur and arsenate of lead. Two teaspoonfuls of Black Leaf 40, one-half ounce of soap, and two ounces of arsenate of lead is the formula used. When used alone or with lime-sulphur, this material was not very effective, but the addition of lead arsenate increased its effectiveness.

RESULTS.

The following treatments proved effective in the order given in controlling the striped beetle in 1917. The materials used

have been explained in previous pages and the results are based on the number of plants that remained after all applications had been completed.

Cucumber:

1st. Protectors.	4th. Land plaster or gypsum.
2d. Arsenate of lead spray.	5th. Air-slaked lime.
3d. Arsenate of lead, dry.	6th. Coal ashes.

Squash:

1st. Protectors.	5th. Black Leaf 40 and lime sulphur.
2d. Land plaster or gypsum.	6th. Fine coal ashes.
3d. Arsenate of lead and Black Leaf 40.	7th. Lime sulphur.
4th. Arsenate of lead, dry.	8th. Black Leaf 40 and soap.

Summary.

When beetles appear in great quantities, they cannot be satisfactorily controlled by simply one method. It is therefore necessary to use different methods in combination. Some of the principal methods which will give satisfactory results are the following:

1. Protectors, young plants.
2. Arsenate of lead, dry; spray alone or in combination.
3. Dusting, arsenate of lead, land plaster, air-slaked lime.
4. Lime-sulphur spray.
5. Planting an abundance of seed; then thinning.
6. Clean culture in fall.
7. Trap crops; squash and beans in spring and fall.
8. Fertilizer used as stimulant.

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THE IMPORTED PINE SAWFLY.

Diprion (Lophyrus) simile Hartig.

By W. E. Britton and M. P. Zappe.

This European pine sawfly was first discovered in this country at New Haven, Conn., in August 1914, by the writers, who, in company with Mr. Irving W. Davis, were inspecting the stock in one of the nurseries. The larvae were feeding upon the leaves of pine trees. As the inspection work continued for several days, we later found the larvae more abundant in another part of the nursery and considerable material was gathered and taken to the laboratory.

Though unfamiliar, we supposed this to be a native, and perhaps not uncommon species. A portion of the collected material was sent to Dr. Alexander D. MacGillivray of the University of Illinois, who was engaged in the study of sawfly larvae, and who at that time had finished preparing the manuscript of the *Tenthredinoidea* for the publication entitled The Hymenoptera of Connecticut, which has since appeared as Bulletin No. 22 of the Connecticut State Geological and Natural History Survey. Dr. MacGillivray was unable to identify the larvae but thought that he might recognize the species if the adults could be obtained.

The larvae in the breeding cages matured in due season and made their cocoons. From this material the first male emerged on April 8, 1915, followed by others, and on April 15 the first female appeared. Males and females were placed in cages containing potted white pines and the females soon laid eggs. On April 21, we wrote to Dr. MacGillivray, informing him of the emergence of the adults. He examined his own cages and found that the adults had emerged there also. He replied that they belonged to the genus *Diprion*, formerly known as *Lophyrus*, but that he did not recognize the species, several of which are

badly confused; that Mr. S. A. Rohwer of the Bureau of Entomology at Washington, D. C., was trying to straighten them out and had already examined many of the types in the British Museum. He suggested that specimens be sent to Mr. Rohwer.

IDENTITY.

Following Dr. MacGillivray's suggestion, on May 6 material was sent to Mr. Rohwer, who soon replied as follows:

"I have determined this species, tentatively, as *Diprion simile* Hartig. The adults agree more closely with those in the collection under the name *pini* but the larvae answer exactly the description of *simile*, and as these two species are very closely allied and easily confused in the adults, I have made the determination from the larvae rather than from the adults.

"This species is one of the most injurious sawflies on European conifers and has been associated in practically all of the depredations caused by *pini*, and is recorded in the literature in a number of cases under the name of *pini*. You are, no doubt, familiar with the economic importance of *Diprion pini* in Europe. It is highly important that immediate measures be taken to combat this injurious insect as it has a large number of host trees and would no doubt adapt itself readily to the conditions in America, where, if it were thoroughly established without its parasites, it would do a great deal of damage."

Though two and one-half years have elapsed since Mr. Rohwer made this identification, and as he has studied the life history and food habits of the species from material furnished by us, a recent communication states that his subsequent observations serve to confirm his tentative identification. We may, therefore, consider it to be fairly well settled that this sawfly is the European *Diprion simile* Hartig. Some of the European writers place *simile* as a synonym of *pini*, but Dr. Enslin and certain other European specialists, as well as Mr. Rohwer, who has studied the species carefully from American and European material, consider them distinct.

PUBLICATIONS FROM THIS DEPARTMENT.

A brief account of the discovery of this insect in the United States was prepared with the help and approval of Mr. Rohwer, and this article, with a plate of illustrations, was published in the Journal of Economic Entomology, Vol. 8, page 379, June, 1915.

A note, with figure of larvae, was also printed in Tree Talk, Vol. 3, page 45, November, 1915.

A more complete account, or at least complete at the time, of our observations on this insect was given with bibliography in the Report of this Station for 1915, page 118. This paper was illustrated by three plates (vii, viii and ix).

A brief paper, "Further Notes on *Diprion simile* Hartig," was prepared to be presented to the Columbus, Ohio, meeting of the American Association of Economic Entomologists in December, 1915, but in the absence of the writer this paper was read by title, and printed in the Journal of Economic Entomology, Vol. 9, page 281, April, 1916.

These papers just mentioned were all prepared by the senior author.

At the New York meeting of the American Association of Economic Entomologists in December, 1916, Mr. Zappe read a short paper entitled "Egg-laying Habits of *Diprion simile* Hartig," which paper appeared in the Journal of Economic Entomology, Vol. 10, page 188, February, 1917.

Since the publication of these papers some additional information has been obtained and all have been brought together in the present paper.

Distribution in Connecticut.

Though first discovered in New Haven, this insect was soon found in Derby, Hartford, Greenwich and New Canaan, five separate towns, and three distinct and rather widely separated regions in the State.

Distribution in the United States.

Diprion simile has now been recorded not only from Connecticut but also from the states of New York and New Jersey, where it was discovered in 1916. In New Jersey it is known to occur at South Orange, Elizabeth and Rutherford.* In New York it has been taken at Flushing, Long Island. In Connecticut, Massachusetts, Pennsylvania, New Jersey, Indiana, and doubtless in other states, cocoons have been found on imported nursery stock coming from Europe.

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* H. B. Weiss, Journal of Economic Entomology, Vol. 10, page 224, February, 1917.

Distribution and Damage in Europe.

This sawfly is mentioned in literature as occurring with *pini*† and therefore responsible for a portion of the damage.

In most cases, however, the serious injury is accredited to *pini*, which has seriously damaged the pine forests of Southwestern Russia‡, especially the young trees; *pini* was particularly destructive in France§ in 1906, and has also caused damage in Prussia and in Sweden. In England it is said to injure Scotch fir‖ as well as pine.¶

In 1914, larvae of *pini* nearly defoliated the ten-year old pine trees on one plantation in Norway.** The insect was reported from many localities. During the same year *pini* denuded many acres of pines in the districts of Achtyr and Izium in Russia,⊙ and caused much damage in Germany, particularly in Brandenburg and Silesia.△

Injury to Trees.

The injury consists in defoliation. The older and mature leaves, instead of the newly-formed ones, are eaten. In late summer the new growth may serve as food for the second brood larvae, so that in this manner the larvae when abundant are able to entirely defoliate trees. Plate VII, b, shows a tree of *Pinus cembra* about seven feet tall almost stripped by the larvae in 1915. Formerly it was supposed that a pine in this condition would not recover. In spite of the fact that the needles were eaten off, the buds were formed for the next season's growth, and the tree put out leaves in 1916 as usual, and as this foliage was protected by spraying, the tree did not seem to be permanently injured. If the tree had not been sprayed and the larvae abundant, the second brood larvae would doubtless have stripped it

† Kaltenbach, Die Pflanzenfeinde, page 700, 1874. Judeich-Nitsche, Forstinsektenkunde, page 635, 1895.

‡ Review of Applied Entomology, Vol. 1, pages 395 and 493, 1913.

§ A. Barbey, Traité d'Entomologique Forestière, page 269, 1913.

‖ W. E. Collinge, A Manual of Injurious Insects, page 217, 1912.

¶ E. A. Ormerod, Manual of Injurious Insects and Methods of Prevention, page 250, 1890.

** Schoyen, T. H., *Review of Applied Entomology, Vol. iv, page 503*, 1916.

⊙ Ibid, Vol. iii, page 443.

△ Ibid, Vol. iv, page 3.

again, and if stripped for a few consecutive seasons, it would surely be killed. According to the published accounts, in Europe the injury seems to be confined to young trees up to twelve or fourteen years of age.

Life History and Habits.

There are two broods each year in Connecticut and the winter is passed in the cocoon on the twigs. The adults begin to emerge in April and continue through May and up to July 20. Meantime most of the first brood larvae had matured and made their cocoons by the middle of June. The second brood larvae feed during August and September.

Thus it will be seen that these broods are not well separated but overlap so that it is often difficult to distinguish them.

The larval stages, on the average, last about 30.5 days. The larvae of the first brood feed upon the old and mature leaves and leave the tender new growth untouched. This new growth becomes sufficiently mature, however, to be used as food by the second brood larvae.

In our studies, nearly all of the cocoons of both broods are fastened to the twigs, but in Europe it is said that the first brood cocoons are so placed, and those of the second brood are found upon the ground.

The larvae feed with their heads toward the tip of the needle as shown on plate VI, and when very young often three or four together surround it. When feeding in this manner they eat all of the needle, but when only one or two feed they eat along the edge of the needle, making it look as though it had been scraped. When the larvae are disturbed they throw their heads back, and from their mouths exude a drop of liquid which they absorb again.

The full grown larvae, in looking for a suitable place to spin cocoons, occasionally crawl into an empty cocoon which is still attached to the tree. Then all that is necessary is to put a new top on the old cocoon. Such a case is shown on plate IX, b.

Number of Broods.

In Connecticut there are two broods (considering a brood from adults to cocoons) and in 1915 a partial third brood was obtained. The adults emerging from the second brood cocoons in this case

emerged late in the summer and were males. The broods overlap somewhat and adults from the first brood of larvae sometimes do not emerge until the following year. It also happens that the adults from the first brood often emerge before some of the adults from over-wintering cocoons.

Adults begin to emerge from over-wintering cocoons as early as April 3 and continue to emerge until July 20, while the greatest number emerge during the last half of May. Adults from the first brood of larvae begin to emerge June 19 and continue until August 28, and in two cases the adults did not emerge until early in June of the following year.

Food Plants.

In our experiments *Diprion simile* has been reared on several species of pine. The following list is arranged according to the preference shown by the sawflies in nature and to the largest number of sawflies reaching maturity in our host plant experiments:

Pinus excelsa Wall. Bhotan Pine.	5-needled pines.
" *cembra* Linn. Stone Pine.	
" *flexilis* James. Limber Pine.	
" *strobus* Linn. White Pine.	
" *Koraiensis* Sieb. & Zucc. Korean Pine.	
" *montana* Du Roi. Mugho Pine.	2-needled pines.
" *densiflora* Sieb. & Zucc. Japanese red Pine.	
" *resinosa* Ait. Red Pine.	
" *sylvestris* Linn. Scotch Pine.	
" *ponderosa* Dougl. Bull Pine.	
" *laricio* Poir. var. *Austriaca* Endl. Austrian Pine.	
" *rigida* Mill. Pitch Pine.	3-needled pine.

The 5-needled pines are preferred as food above other species and it is very easy to rear larvae on these kinds. The 2-needled species are attacked, especially the softer-needled kinds. Those having hard, stiff needles, like the Scotch, bull and Austrian pines, are almost immune. In the nursery no very young larvae were found on these species but nearly full grown ones were often found. Several attempts have been made to obtain adults from egg stage on Austrian pine but all were failures. The larvae during the first instar although many of them had started

to feed. Larvae which had passed the second moult on other pines and were then transferred to Austrian pine, lived and adults of both sexes emerged from the cocoons.

Eggs have been laid on pitch pine, but like Austrian pine, the larvae fed on the needles for about a week, but all died before the first moult. Attempts were made to obtain eggs and rear larvae on other conifers without success except that a few eggs were laid on white spruce; these hatched but the larvae did not feed.

MOULTS.

The larvae of this sawfly pass through five moults before they reach the pupa stage. The time between moults varies, the earlier instars from first to third are only two or three days, while the later ones are from four to seven days. The markings on the larvae do not appear distinctly until after the third moult; then they do not change in appearance except for size until they reach the prepupal stage. After this moult the larvae are much lighter in color and eye spots appear. The larvae now stop feeding and look for a suitable place to spin a cocoon, which they usually accomplish in a day or two.

1st Instar.

Larvae when just hatched have light, slate-colored bodies, head lighter, with two eye spots. After a few hours the head becomes shiny black and the eye spots disappear, thoracic legs also become black, body becomes yellowish green, semi-transparent, and the food inside the body showing darker green.

2d Instar.

Larvae look very much like those of the 1st instar except that they are a little larger. No markings are visible yet.

3d Instar.

Not much change in appearance from previous instars. Body a little darker than in 1st and 2d instars.

4th Instar.

Markings show plainly. Head and legs shiny black. There is a double black dorsal line extending the entire length of the body. On either side of the dorsal stripe there is a yellow stripe broken with transverse markings of brown. Lateral surface dark brown with many irregular yellow spots. Yellow markings protrude, making them look somewhat like blisters. Ventral surface pale yellow. Prolegs pale yellow, with transverse black marks at

base. True legs black, yellow at the joints. Body sparsely covered with minute spines; more spiny at posterior end of larva.

5th Instar.

Markings same as in 4th instar except that they are brighter, the dark portions much darker, giving the larva a somewhat darker appearance.

6th Instar (prepupal stage).

Head greenish with black eye spots. Legs light green, markings same as in other moults but colors very light, making general appearance of larva much lighter. Prolegs not very well developed in this stage and are of little use, larva falling from twigs very easily.

Larvae now spin cocoons and remain in larval stage until shortly before adults emerge, when they pupate. The pupal stage lasts only for a few days.

Description.

The appearance of this insect in all its stages is shown on plate VI, and briefly may be described as follows:

Egg. The eggs are laid end to end in slits made along one of the ridges at the edge of the needle as shown on plates VI, 2, and IX, c. The eggs are pale blue in color, smooth and slightly shining. The sides are parallel with the ends rounded. Length, 1.25 mm., thickness, .33 mm. In the material examined the newly-laid eggs were slightly separated in the slits. The eggs before hatching increase in size, becoming crowded in the slits so that the ends are flattened like peas in a pod.

Larva. Length, 25 mm. (1 inch) to 28 mm. ($1\frac{1}{8}$ inches). Thickness, 4 mm. (5/32 inch). Head black, body greenish-yellow with a mid-dorsal double stripe of brown extending the entire length. On either side of the dorsal stripe is a yellow stripe broken with transverse markings of brown. The remainder of sides dark brown with many irregular yellow or whitish spots. Ventral surface pale yellow or white. Prolegs yellow with a transverse black mark at base, true legs marked with black and yellow. Shown on plate VIII, b.

Cocoon.—9 mm. long (about 3/8 inch), thickness about 5 mm., oval in shape, tough, leathery and fairly smooth. Color, sepia. See plate VIII, c.

Male. Wing-spread, 14 mm. (9/16 inch). Length, 7 mm. Large pectinate antennae. Head and pronotum coarsely punctured. Head, antennae and body, black. Cerci and tip of the last abdominal segment, orange. Legs yellow, with the trochanters and basal two-thirds of the femora, brownish black. Shown at the right on plate VI, 1.

Female. Wing-spread, 20 mm. (little over 3/4 inch). Length, 8 mm. (5/16 inch). Robust, head and antennae black. Thorax coarsely punctured, yellow with a large shield-shaped black spot on mesothorax, extending from the anterior margin and covering about two-thirds of the space between the parapsidal grooves. On either side are a pair of L-shaped black marks which approach each other posteriorly. Posterior margin of the mesothorax, postscutellum and prosternum, black. Abdomen yellow with dorsal surface of 3d, 4th, 5th, 6th and the anterior portion of 7th segment, black. Legs yellow with the outer surface of hind femora, the apex of the middle and hind tarsi, dark. Shown at the left on plate VI, 1.

Egg-Laying Habits of the Female.

On emerging from the cocoons in the breeding cages, the females begin to run aimlessly about, going all over the pine twigs for a period which is more or less indefinite but which usually averages about twenty-four hours. They then commence to deposit eggs. In ovipositing the female places herself on the pine needle facing its tip, and grasps it firmly with her tarsi, the hind legs extending slightly beyond the abdomen. The ovipositor is then inserted in the edge of the needle and a slit is cut in it, working from the base toward the tip. When this incision has reached a length of about one-tenth of an inch, the sawfly rests for a few seconds, then lays an egg placed horizontally in the slit, gradually drawing the ovipositor backward and out of the needle. This withdrawing of the ovipositor partially covers the egg with resin and sawed pulp from the leaf. She then moves forward and proceeds to cut a slit in which the next egg is placed. The eggs are thus placed end to end in the incision, as many as twenty sometimes being placed in line in the needle as shown on plate IX, c. The time required to lay a single egg is about four minutes in *Pinus excelsa* and about five minutes in *Pinus densiflora*.

The females usually begin to lay eggs in about a day after emerging from the cocoons, and live for about seven days, while those individuals (about eleven per cent.) which do not oviposit die in four or five days. With the males the length of life varies; some individuals live longer than the females, and some do not.

The eggs are usually laid in needles of the previous season's growth, if such are present. Most of the eggs for the first brood hatch during the first half of May, and those for the second brood early in August, though the broods overlap, and it sometimes happens that some of the first brood females are so late in emerging from their cocoons that their eggs do not produce larvae until after some of the second brood eggs have hatched.

Number of Eggs Laid.

Upon dissecting the bodies of females from over-wintering cocoons, an average of 58 eggs was found in each. The number of eggs in a female of the first brood averaged 76, while those of the second brood averaged 74. The largest number of eggs recorded as having been laid by one female was 128; this is more than we ever dissected from the body of any female sawfly. The average number of eggs laid was 64.

Parthenogenesis.

In our studies of this insect, copulation has been observed only once, but eggs are laid which develop and hatch if males are not present. Moreover, the presence or absence of males has no apparent effect on the number of eggs laid. Some females oviposit when males are present and others do not. The only time copulation was observed, the pair of adults were transferred to a breeding cage to obtain eggs and larvae. The female died in a few days and upon examining the cage no eggs were found.

In thirteen cases the adults reared from eggs laid by virgin females were all males. Out in the field under natural conditions the number of females emerging from over-wintering cocoons was slightly greater than that of males. Out of 1,675 adults from over-wintering cocoons, 912 were females and 763 were males. During the summer of 1917 a freak adult or gynandro-

morph emerged from some cocoons collected in the field. It has one female antenna and the other is that of a male sawfly. The left side, including antenna and markings on thorax, is that of a female, while the right side has a male antenna and the thorax is without markings—just black like the males. The abdomen is darker than that of a female, yet lighter than that of a male. It also has the characteristic female ovipositor. The specimen was killed in a cyanide tube before we discovered that it was a freak. This specimen is shown on plate IX, d.

PARASITES.

About twenty-eight per cent. of the cocoons of *Diprion simile* collected during the winters of 1915–16 and 1916–17 showed the exit holes of parasites. Following is a list of the nine specie reared, arranged in the order of their abundance:

Hymenoptera.

Dibrachys nigrocyaneus Norton (*Pachyneuron*), *Monodontomerus dentipes* Boheman, *Dibrachoides verditer* Norton (*Pteromalus*), *Delomerista* n. sp., *Cerambycobius* sp. (probably new), *Eurytoma* sp., *Hemiteles utilis* Norton.

Diptera.

Exorista petiolata Coquillett.

Of these nine species of parasites only the first three were reared in sufficient numbers to indicate that they are at all effective in holding the pest in check, and of the three, *Dibrachys nigrocyaneus* Norton was by far the most abundant.

During the winter of 1916–17, 3,240 cocoons were collected. Of these, adults emerged from 41 per cent., 37 per cent. were parasitized, and 6 per cent. were torn open by birds, mice or squirrels, and the pupae eaten. The remaining 16 per cent. produced no living insects, but when the cocoons were opened a large number of them contained dipterous pupae; in some of these the adult flies had broken off the ends of their pupa cases preparatory to emerging. See plate IX e. Tachinid eggs were found on many of the *Diprion* larvae in the field, but only one fly (*Exorista petiolata* Coquillett) has been reared. Apparently all of the others have been unable to escape from the tough *Diprion simile* cocoons. The cocoons of our native species are not as tough as those of *D. simile.*

The figures and percentages mentioned in the preceding paragraph are shown in the following table:

Cocoons Collected During Winter 1916–1917.

	Number	Percentage
Adult sawflies emerged	1,321	41
Parasites emerged	1,210	37
Torn open and eaten	191	6
Dead	518	16
Total	3,240	100

In the field many dead larvae were found on the trees suspended by their prolegs, having been killed by a wilt disease. This disease seems to be the most prevalent late in the season, and is effective in killing the larvae of the second brood. It also seems to be more prevalent on trees which have been stripped, though possibly it is because they are more conspicuous on such trees.

In regard to the insect parasites listed above, all those specifically identified are native species with the exception of *Monodontomerus dentipes* Boh., which is a European species which had been found previously in the United States. *Dibrachoides verditer* Norton and *Dibrachys nigrocyaneus* Norton were originally described from Connecticut.

Probably Introduced on Nursery Stock.

The most plausible theory is that this sawfly was brought into this country on nursery stock. A few cocoons attached to the leaf-covered twigs might easily escape notice by the inspector in examining the imported stock, especially before its presence in this country was discovered. Cocoons might also occur in the ball of earth on the roots, as it is seldom possible with the help and funds available in Connecticut to examine carefully the soil about the roots. Empty sawfly cocoons have been found in cases of azaleas from Belgium.

Since 1909, when nests of the brown-tail moth were found on nursery stock coming into this country from Europe, an attempt has been made to inspect all shipments of field-grown woody plants coming into Connecticut from all foreign countries. At first it was impossible to trace all shipments and we were obliged to depend chiefly upon information furnished us by the nurserymen. Most of the importations arriving at the principal nurseries were

inspected but florists and private owners also made importations and there were unquestionably a number of shipments each year which were not examined. On the establishment of the Federal Horticultural Board in 1912, the system of permits and notices has enabled us to trace each shipment and practically all such stock has been examined. But there were probably many shipments brought into the State prior to 1909, and these were not inspected at all. On account of the blister rust diseases and the pine shoot moth, all pines are now prohibited from entering the United States from Europe.

Since the establishment of the Federal Horticultural Board and the present system of inspecting imported nursery stock, sawfly material has been intercepted at least eleven times, as follows:

Sawfly	Host	Source	Destination
Cocoon........	Fruit trees.......	England.......	New Jersey
Larva.........	Box.............	Holland.......	Indiana
Diprion pini....	Mugho pine......	"	Massachusetts
Cocoon........	Spruce..........	"	Nebraska
"	Azalea..........	Japan.........	New Jersey
" (empty)	"	Belgium.......	Connecticut
Diprion simile..	?	Holland.......	Indiana
Cocoon........	Quince..........	France........	Nebraska

It will probably never be known just how, when or where this insect was first brought into the United States. Possibly it was first introduced into the very nursery where it was first discovered, though other nurserymen in Connecticut and hundreds of them in other states have imported pines from Europe, and the insect might have come in any of these shipments.

Danger to the Pine-Growing Industry in the United States.

It is impossible to foretell how serious a pest this sawfly may become in the United States. Any introduced insect which feeds upon an important crop is dangerous; doubly so if its natural enemies are left behind. As the food plants of *Diprion simile* are fairly abundant in this part of the country, and the climate seems to be favorable, it is probable a question of parasites and other natural enemies that will determine its status as a pest here. It is encouraging that our native species parasitize it so freely.

CONTROL MEASURES.

In each infested nursery in Connecticut, the owner has been required to spray the pines with lead arsenate (3 lbs. in 50 gallons of water) late in summer when the second brood of larvae were feeding. Later, after all larvae had transformed, a careful inspection was made of each tree and all cocoons removed. These measures appeared to be necessary in order to reduce to the minimum the danger of further distributing this pest on nursery stock. A similar spraying early in May would forestall injury by the first brood of larvae.

Ornamental trees and small plantings on private grounds can likewise be sprayed, but the cost would be prohibitive in large forest areas.

In Europe it is recommended that the leaves and other rubbish be gathered and burned late in fall in order to destroy the cocoons, but this method can hardly be advised in this country, as all the cocoons are fastened to the twigs. Some cocoons were found upon the ground during the winter and spring, but these had probably been torn off by snow or ice storms, or possibly by birds.

In Russia, V. G. Averin* recommends as control measures that larvae be shaken into pails, crushed on the branches with leather gloves, and that the trees be sprayed with barium chloride (5 lbs. in 27 gallons water) and with Paris green.

In Germany,† outbreaks were checked by collecting the larvae and by spraying with petroleum soap emulsion. It is said that on an estate of about 150 acres near Danzig in 1905, the pines were cleared of 1,412 litres (5,600,000 individuals) of larvae at a cost of about $50.00. The following year (1906) about half of this area or 75 acres were cleared of 201 litres (800,000 individuals) at a cost of about $7.00.

ACKNOWLEDGMENT.

The writers herewith express their indebtedness and thanks to Mr. S. A. Rohwer of the Bureau of Entomology, Washington, D. C., who has identified specimens, furnished references and examined the manuscript of this bulletin.

* Journal of Applied Entomology, Vol. iii, p. 106, 1915.
† Ibid, vol. iii, page 3, 1915.

SUMMARY.

Diprion simile, a dangerous European sawfly, has been brought into the United States, probably on nursery stock. It was first discovered in Connecticut in 1914, but has since been found in New Jersey and New York, having apparently become established in these three states independently. It has also been found on imports entering Massachusetts and Pennsylvania.

In Europe this sawfly has been associated with *Diprion pini* in many serious outbreaks, notably in Russia, Germany, France, Norway, Sweden and England.

The larvae injure pine trees by feeding upon the leaves of several species, preferring the five-needled pines. There are two generations in Connecticut, and possibly a partial third generation in favorable seasons.

This insect passes the winter in the cocoon stage on the twigs and the adults begin to emerge the latter part of April. Egg-laying soon begins in the needles of the previous season's growth. The first brood larvae feed during May and early June, and the second brood larvae feed during August and September. Each female lays, on the average, 64 eggs. The first brood larvae feed on the old needles rather than the new tender growth, but this new growth becomes sufficiently mature to serve as food for the second brood larvae. Thus trees may be stripped in one season.

The larva moults five times before reaching the pupa stage, and when fully grown is about an inch long, with body greenish-yellow, with a double brownish stripe extending along the back. On each side of this stripe is a yellow stripe crossed by narrow brown markings. Head black.

The adults are robust, with transverse clouded areas on the wings. The female has slender antennae, and thorax and abdomen are yellow with black markings; the male has broad, pectinate antennae and is nearly all black.

Apparently this sawfly is parthenogenetic, for without the intervention of males, eggs are laid which hatch and develop normally.

The cocoons are strongly parasitized, nearly 50 per cent. being killed. Eight species of hymenopterous parasites and one dipterous parasite have been reared. Three of the former, *Dibrachys nigro-cyaneus*, *Monodontomerus dentipes* and *Dibrachoides verditer*, bid

fair to become effective in checking the pest. Of these, the first is by far the most abundant. The first and third are native American insects, and the second is a European species which has previously been recorded from the United States.

Whether or not this sawfly seriously injures the pine growing industry in this country probably depends on its parasites.

Spraying the pines with lead arsenate early in May, and again in August, and destroying the larvae and cocoons when found, are the control measures to be practiced.

This insect in its various stages is shown on plates VI-IX.

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OUTBREAK OF THE PINK AND GREEN POTATO APHID, *Macrosiphum solanifolii* Ashmead.

By W. E. Britton and Q. S. Lowry.

On July 9th, while the entomologist was absent on a vacation, several inquiries were received at the office about aphids on potatoes. The Frank S. Platt Company of New Haven telephoned that it had received complaints from all over the State, and asked for a remedy. Nicotine solution was advised. For a period of about two weeks there were many inquiries by telephone and by mail from various parts of the State, but chiefly from Hartford

Waterbury, New Haven and the regions surrounding these cities, and Mr. Lowry was kept busy answering them.

There was such a demand for information, and prompt action being necessary, that the Director, after conferring with the assistant entomologists, prepared the following press notice, which appeared in the daily papers of July 16th:

"DANGER FROM THE POTATO APHID.

An aphid or plant louse is very abundant on potato vines now and threatens very extensive damage to the crop.

Control by spraying now is very difficult because of the heavy growth of vines and the fact that the lice are abundant on the lower surface of the leaves.

Spraying the upper surface alone is not effective. The best remedy that we can recommend is a nicotine spray with soap solution made as follows:

One-half pint 'Black Leaf 40' and two pounds whale oil soap or yellow soap dissolved in a barrel of water. For use on a small scale dissolve one to one and one-half teaspoonfuls of 'Black Leaf 40' in a gallon of water, with a piece of soap about an inch square. Any other tobacco preparation may be substituted which carries as much nicotine as the one named above. The full amount given in the manufacturer's directions should be used. To be effective the spray must cover not only the upper surface but the under side of the leaves as well, and also the tender stems, therefore the spray must be directed in part from beneath upward. This spray containing soap cannot be applied with Bordeaux mixture but may follow or precede it by a few days."

Infested potato fields were reported from every county in the State and from the following localities:

Fairfield County—South Norwalk (turnip), Redding.

New Haven County—New Haven, Westville, North Haven, Montowese, West Haven, Mount Carmel, Cheshire, Branford, North Branford, Meriden, Middlebury, South Britain, Naugatuck, Waterbury.

Middlesex County—Middletown.

New London County—New London.

Litchfield County—Harwinton, Thomaston.

Hartford County—Hartford, East Hartford, Thompsonville, Wethersfield, Farmington, New Britain, Plainville, Bristol.

Tolland County—Bolton.

Windham County—Killingly.

It was doubtless present in many other localities, though not reported to the Station.

In 1903 this aphid was abundant on potatoes in Fairfield, and in 1909 it was found on potatoes in the Station garden by Mr. Arthur I. Bourne, then an assistant in this department. On July 18, 1912, it was received on both potato and corn from Mr. Noyes Palmer of Stonington, and on potato from Mr. Alfred L. Beebe of Mystic. These last-mentioned infestations were apparently local, and no great or widespread damage was reported.

Prior Connecticut Records of this Species.

The aphid material in the Station collection was determined chiefly by Dr. Edith M. Patch of the Maine Agricultural Experiment Station, Orono, Me., and contains several microscope slides of *Macrosiphum solanifolii* Ashm. From these the following data are taken:

Host	Locality	Date	Collector
Potato	Mystic	18 July, 1912	A. L. Beebe.
Tobacco	So. Glastonbury	27 July, 1904	W. E. Britton.
	New Haven	22 July, 1909	A. I. Bourne.
Ground Cherry (*Physalis pubescens*)			
	Meriden	21 Sept., 1908	W. E. Britton.
Jerusalem Cherry (*Solanum pseudocapsicum*)			
	New Haven	27 July, 1909	A. I. Bourne.
Squash	New Haven	21 July, 1909	A. I. Bourne.
		8 July, 1914	M. P. Zappe.
Beet	New Haven	30 July, 1909	A. I. Bourne.
	Milford	19 July, 1915	W. E. Britton.
Lettuce	New Haven	22 July, 1909	A. I. Bourne.
Milkweed (*Asclepias* sp.)			
	New Haven	29 June, 1916	B. H. Walden.
Clematis crispa	New Haven	18 June, 1901	W. E. Britton.
Bitter Sweet (*Celastrus scandens*)			
	Windsor	19 June, 1912	Mrs. Mary Allen.

Distribution in the United States.

This aphid was first described from Florida by Ashmead in 1882, on wild pepper vine, *Solanum jasminoides*. As it has also been recorded from Maine, Canada, California, and a number of the states between, it is fair to assume that it may occur throughout the United States.

Davis,* writing in 1904, states: "Although not commonly and generally a pest of the potato in Illinois, I have occasionally found it exceptionally and injuriously abundant."

* Jour. Econ. Ent. Vol. 4, page 330, 1904.

In 1904, 1905 and 1906, this insect was prevalent in Aroostook County, Maine, and caused much damage to the potato crop.

Certain potato fields in Iowa** were infested in 1912, but natural enemies promptly checked the outbreak before much damage was done.

According to available reports, aphids were prevalent on potatoes in 1917, in Illinois, Indiana, Missouri, Kentucky, Ohio, Pennsylvania, Maryland, Virginia, District of Columbia, New Jersey, New York and Massachusetts, as well as in Connecticut. Possibly in some cases the damage was done by another species, known as the green peach aphid, or spinach aphid, *Myzus persicae Sulz.*, which is common everywhere, and which seemed to be the chief species on potatoes in some of the southernmost states named above. This aphid may attack almost any kind of vegetable crops.

INJURY.

The aphids caused the leaves to curl and the plant to assume the appearance shown on plate X, a. The leaves soon turned brown on the edges and the vines were soon killed. Apparently this infestation seriously checked the crop; the tubers were arrested in their development and a very small yield resulted. In a field at the Station farm at Mt. Carmel, the vines were large and vigorous and promised a good crop; but this field was heavily infested with aphids in July, and though sprayed and most of the aphids killed, the plants did not recover and died in a few days. The yield was very small, some portions of the field being hardly worth digging. Plate XI,b, shows a field where the vines have been killed by aphids.

On the other hand, Mr. A. N. Farnham of New Haven raised one of the best crops of potatoes in 1917 that he has ever grown. He planted early varieties as soon as the ground could be worked and matured the crop before the aphids came. One field at the Station farm gave a fair yield, but this was an early variety planted late, and was not attacked by aphids.

The aphids are usually on the under side of the leaves and on the tender shoots of the potato. The following account of injury is taken from Bulletin 317, Ohio Agricultural Experiment Station, page 69:

** Bull. 155, Iowa Agr. Expt. Sta., page 400, 1915.

"The tender leaves on the tip of the plant are first to be attacked; and as the leaf develops and the lice continue their sap-sucking, devitalizing work, the edges turn downward and after a short time the whole structure takes on the distorted, contracted aspect so characteristic of the work of many aphids.

"In the later stages, the plant dies from the top downward. It is difficult to determine the actual damage the insect inflicts in cases where the plant is not killed outright. Unquestionably the production of tubers is minimized when the leaves of the top become badly curled; indeed, the curtailment may be considerably greater than is realized. In addition to the primary harm inflicted, we must attribute a part of the damage caused by plant diseases directly to the aphids, since on account of their well-known migrating habits they unquestionably are a factor in disease dissemination."

On tomato in Ohio no fields or plants were killed outright, though the aphids, as on potato, attack the tender shoots and leaves and cause the leaves to curl. A favorite place is on the blossom clusters, and they cause the blossoms to fall without the fruit setting, thus greatly reducing the yield. On egg-plant and pepper the greatest injury, as on tomato, resulted from a failure to set fruit on account of the stems being devitalized by the attacks of the aphids.

Dr. Felt estimates that on Long Island and in the southern part of New York state, where the aphid attacks were the most severe, at least one-fourth of the potato fields were very seriously damaged, and the vines killed.

Habits and Life History.

This aphid passes the winter in the form of a shining, oval, black egg, which, according to Dr. Patch, occurs more often upon the rose than any other plant. On the approach of warm weather in spring these eggs hatch into agamic viviparous females, which are usually found on the new rose shoots and especially around the flower buds in early summer. Some of these females acquire wings and fly to the potato fields; the wingless forms travel by walking if a potato patch is sufficiently near. Thus usually by July 1st the aphids have become colonized on potato and only a few stragglers are left upon rose.

According to Dr. Patch, a female may produce 50 or more young in two weeks, and in warm weather these may become mature in two weeks and in turn begin to produce living young.

On the potato the aphids seem to find favorable conditions for growth and development and increase at an enormous rate. In Ohio only ten days are required for the young to reach maturity; hence several generations are possible during the summer breeding season. Finally a true sexual generation is developed in the fall, consisting of winged males and wingless females, the latter laying eggs on the rose or other host to carry the species through the winter. In Ohio, studies were made on the rate of reproduction. One female was caged on a plant which had been freed from its entire aphid population, and at the end of two weeks the colony consisted of 76 aphids, five of which were producing young. Counts were made of the aphids on three tomato plants: No. 1, a small one having seven leaves, had 1237 aphids; No. 2, a large branching plant with 12 stalks, had 34,688 aphids; No. 3, also a large spreading plant, had 25,750 aphids. Plate X, a, shows a tomato shoot infested with aphids.

Both Dr. Patch in Maine and Mr. Houser in Ohio noticed the strong tendency of the winged forms to drop to the ground when the host plant is disturbed.

Host Plants.

Besides attacking potato, this aphid injures tomato and egg-plant, and is found on many other hosts. In Ohio in 1917*, potatoes, tomatoes, egg-plants and peppers were attacked and severely injured. In Connecticut, we have only one report to show that it infested tomato, one on turnip, and none to show that it caused injury to plants other than potato in 1917. A list of the known host plants follows: Potato, tomato, egg-plant, pepper, pea, sunflower, rag-weed, jimson weed, lambs quarters, sweet potato, turnip, ground cherry (*Physalis*), shepherd's purse, canna, hollyhock, matrimony vine, corn, beans, plantain, moth mullein, smartweed, curly dock, catalpa, pokeberry, iris, gladiolus, red-root pigweed, apple, pepper-vine, aster, cineraria, buckwheat, rose and lettuce.

In 1912, this insect was received on corn and potatoes from Stonington, the potato leaves being badly infested.

Description.

The appearance of the winged viviparous female is shown in figure 3.

*Bull. 317, Ohio Agr. Expt. Station, November, 1917.

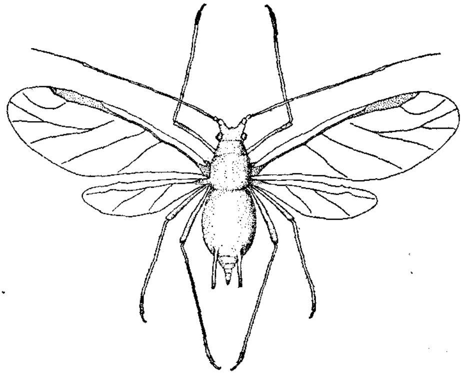

Figure 3. The potato aphid, winged female, summer form.
Greatly enlarged.

The following description was published by Dr. Patch in Bulletin 242, of the Maine Agricultural Experiment Station, page 208:

"In general *Macrosiphum solanifolii* is a large species either green or pink. The apterous forms are somewhat inclined to drop from the plant when disturbed. The abdomen is not marked with dark, but is ordinarily clear in color either pink or green, though sometimes late in the season individuals may be found with a mottling part pink and part green. The mature forms are rather glistening, but in the stage previous to the last molt the insect usually has a mid-dorsal line of dark green or pink (according to the color of the individual) while the rest of the dorsum is paler by virtue of a very slight powdery deposit. This appearance is more noticeable in bright light. The beak is short, usually, not or barely reaching the second coxa, though certain collections have been taken with beaks a little longer. The cornicles are characterized by reticulations at the tip. This reticulation holds true for all the mature individuals—alate and apterous viviparous females, oviparous females, and males—whether of the green or pink variety, and regardless of the food plant upon which they have developed. The cornicles of the immature individuals are not so marked. The antennae of the apterous

females are a little swollen at the proximal part of III. where a few sensoria are placed; those of the alate females have the sensoria in a single row not extending to the distal tip of III. The wing veins are clear cut and well defined though slender.

"The foregoing are the general recognition marks. There is no structural difference between the spring and the fall individuals great enough to lead one to think they might be different species; though there is a range in size, influenced by food plant or other conditions, great enough to cause hesitation in determining certain collections unless the progenitors are known. The measurements, therefore, in the following descriptions can only be taken as approximate.

"*Winged viviparous female, green variety.* Head yellowish green. Beak typically barely reaching second coxa, though in some collections a little longer. Antennae, proximal segments pale green, distal segments dark; length of segments: III, .88 to .96 mm.; IV, .76 to .9 mm.; V, .64 to .72 mm.; VI, base .16 to .2 mm.; VI, spur .96 to 1.12 mm.; total length I to VI, 3.6 to 4.05 mm. III with single row of sensoria somewhat irregular in size numbering 18 or a few more or less, not extending to distal end. Prothorax and thorax light yellowish green, lobes brownish. Wings hyaline, veins dark brown, very slender and clear cut, stigma pale brown. Total wing expansion 8.1 mm. Legs with proximal part of femora and tibiae pale, tarsi and distal part of femora and tibiae dark. Tarsi .16 to .2 mm. Abdomen light green unmarked dorsally or ventrally. Cornicles, with proximal portion green and distal portion dark brown, imbricated for more than three-fourths its length but strongly reticulated at tip, cylindrical, length .95 mm. or about five times length of tarsus. Cauda light green, ensiform, length .48 mm. or about one-half length of cornicles. Total length of body to distal tip of cauda and exclusive of antennae 2.9 to 3.37 mm.

"*Winged viviparous female, pink variety.* Head light yellowish. Antennae with I and II light yellowish, rest dark. Sensoria as with the green variety. Prothorax and thorax light yellowish pink. Abdomen pale pink. Cornicles light yellow with tips dusky and strongly reticulated. Cauda pink. Measurements the same as with the green variety.

"*Wingless viviparous female.* Color either pink or green as with the winged viviparous form. Antennae, length of segments: III, .8 to .96 mm.; IV, .72 to .88 mm.; V, .56 to .72 mm.; VI, base .16 to .2 mm.; VI, spur .96 to 1.2 mm.; total length of segments I to VI, average about 4.05 mm. III slightly swollen at basal third where 1 to 5 sensoria occur. Cornicles .96 to 1.04 mm. in length, and strongly reticulated at tip about one-fifth the distance. Cauda .56 mm. Total length of body to distal tip of cauda exclusive of antennae, 4.05 mm.

"*Wingless oviparous female.* Head pale, nearly white. Antennae with proximal joints pale, distal half dark. Length of segments: III, .68 to .88 mm.; IV, .56 to .68 mm.; V, .52 to .64 mm.; VI, base .16 mm.; VI, spur .96 to 1.04 mm.; total antennal length I to VI average about 3.6 mm. Legs with femora and tibiae, proximal portion pale, distal

portion dusky. Tarsi dark, .16 mm. long. Hind tibiae conspicuously darker and much swollen and thickly set with sensoria. Abdomen light salmon pink. Cornicles pale at base, distal half dark and reticulated at tip; length .6 to .8 mm. Cauda salmon pink, ensiform, length .32 to .4 mm. Total body length to tip of cauda, antennae excluded, 2.13 to 2.15 mm. The size of the hind tibiae of this form makes it readily distinguished from the apterous viviparous form and young, even to the unaided eye.

"The pink variety has been described because these predominate among the oviparous females. The color scheme of the green and yellow forms can be determined merely by substituting these colors for the salmon pink of the individual described, the dark coloration being the same for all three.

"*Winged male.* Head and antennae dark brown. Length of antennal segments: III, .72 to .8 mm.; IV, .48 to .64 mm.; V, .48 to .6 mm.; VI, base .16 mm.; VI, spur 1.04 to 1.28 mm.; total antennal length I to VI, 2.93 to 3.60 mm. Sensoria numerous on III, usually none on IV, and an irregular row of them nearly the whole length of V. Prothorax and thorax dark brown. Wings hyaline, veins dark and very slender, stigma pale brown. Legs brown, darker at tips. Abdomen greenish or brown. Cornicles pale brown, dark distally and reticulated, cylindrical, .48 to .56 mm. long. Total body length exclusive of antennae and cornicles, 1.12 to 1.57 mm. The thorax is large and strong, the abdomen much shrunken, making the cornicles seem conspicuously long. The male is described from individuals taken in copulation, in order that no mistake as to the identity of the species might occur."

Parasites and Natural Enemies.

Nearly all aphids are preyed upon by adults and larvae of lady beetles, and by the larvae of lace-wing flies and syrphid flies, and these were all observed in connection with aphids on potato in Connecticut, though we did not have time to study them and to rear and identify the species. A lace-wing larva, a lady-beetle larva, and a syrphid larva are shown on plate XI, a.

In Ohio the following nine species of adult lady-beetles were observed feeding upon the aphids:* The two-spotted lady-beetle, *Adalia bipunctata*, the nine-spotted lady-beetle, *Coccinella novemnotata* (ix-*notata*), the red lady-beetle, *Cycloneda munda* (usually listed as *Coccinella sanguinea*, a tropical species), the convergent lady-beetle, *Hippodamia convergens*, the glacial lady-beetle, *H. glacialis*, the parenthesis lady-beetle, *H. parenthesis*, the thirteen-spotted lady-beetle, *H.* xiii-*punctata*, the spotted lady-beetle, *Megilla fuscilabris* (usually listed as *maculata*, a tropical

* Bull. 317, Ohio Agr. Expt. Station, page 78, November, 1917.

species) and *Brachyacantha ursina*. The most common species were *Hippodamia convergens* and *Coccinella novemnotata*. An adult of the latter was observed to eat six aphids in 22 minutes, and a larva ate three aphids in 12 minutes.

The larva of a species of *Chrysopa* or lace-wing fly, though present and feeding upon the aphids, was not sufficiently abundant to be an important factor in checking the pest.

Three species of syrphid flies, *Syrphus americana*, *Sphaerophoria cylindrica* and *Allograpta obliqua*, in the larval stage fed upon the aphids.

The above mentioned lady-beetles, lace-wing fly and syrphid fly larvae are predaceous and devour the aphids in large numbers. There are also the four-winged or hymenopterous parasites, of which four species were very abundant in Ohio, namely, *Aphidius polygonaphis*, *Pachyneuron aphidivorum*, and two species of *Lygocerus*, the first being the most abundant. These are internal parasites, and are very effective in keeping aphids in check. When parasitized by them, the aphids become swollen, turn brown and remain fastened to the leaves. Such parasitized aphids were noticed on some of the potato leaves brought to the Station. These or similar natural enemies have been observed in Maine and Iowa attacking potato aphids.

Mr. Zappe collected some parasitized aphids on potatoes in Stratford, July 23, 1917. On July 26 and 30 some small ichneumon or four-winged flies emerged from them. These parasites were sent to the Bureau of Entomology, and through the kindness of Dr. L. O. Howard were identified by Mr. A. B. Gahan. All proved to be *Aphidius rosae* Halliday, a species which has several times been collected or reared within the State.

All of the lady beetles, the syrphid flies and the lace-wing mentioned above are common species in Connecticut. Though the four-winged flies found in Ohio have not so far been recorded from Connecticut, it is probable that they occur here. At any rate, these or closely allied species are certain to be present in Connecticut fields and serve as important checks in any aphid infestation.

In Ohio, chickens, the English sparrow, the chipping sparrow and the quail were observed to feed on potato aphids. A fungus, *Empusa* (*Entomopthora*) sp., killed many of the aphids, particularly during rainy periods. Possibly this is the same species that

attacked the turnip aphid in Connecticut in 1916, and which was identified as *Entomopthora aphidis* Hoff. by Dr. A. T. Speare of the Bureau of Entomology.

CONTROL METHODS.

Spraying with Nicotine Solution. The means advised by the Station and practiced by many growers for immediate relief was to spray the vines with nicotine solution to kill all aphids which are hit by the spray. There are several nicotine preparations on the market, such as "Black Leaf 40," made by the Kentucky Tobacco Product Company, Louisville, Ky.; "Nikoteen," made by the Nikotine Manufacturing Company, St. Louis, Ky.; and "Pratts' Nicotine," made by The B. G. Pratt Company, 50 Church St., New York, N. Y.

One of the best-known of these preparations, and perhaps the one most widely sold in Connecticut, is "Black Leaf 40." This is a heavy liquid containing 40 per cent. of nicotine in the form of sulphate. It will kill most kinds of aphids if diluted at the rate of one teaspoonful in a gallon of water, or one-half pint in a barrel of 50 gallons. If a little soap be added, it will spread and cover the foliage better. For this purpose a piece of soap an inch square to a gallon, or two pounds to a barrel, will answer. For field spraying, therefore, to kill aphids on potatoes, the following formula should be used:

"Black Leaf 40"	1 pint
Laundry soap	2 pounds
Water	50 gallons.

The nicotine solution may be added to Bordeaux mixture, lime-sulphur or lead arsenate, but when used in combination with these materials the soap should be omitted on account of possible chemical changes, forming soluble salts of copper, lime or arsenic, liable to injure the foliage. There was some misunderstanding on the part of the growers regarding the directions contained in the press notice issued on July 16 (See page 291), which reads: "This spray containing soap cannot be applied with Bordeaux mixture but may follow or precede it by a few days." The reason for this statement has already been explained above. Some growers wish to eliminate one spraying, and may do so by adding the "Black Leaf 40" to the Bordeaux mixture, and there is no danger if the soap is omitted.

To kill aphids very thorough work is essential. Most of the aphids are on the tender shoots and on the under side of the leaves, many of which are curled. As the spray will kill only those aphids which are hit by it, it is imperative that a successful spray be directed against the under surface of the leaves and also be thrown against the plant from opposite sides. It is almost impossible to hit all of them by a single treatment. Repeated applications are therefore necessary in some cases. It is extremely important to watch the fields and to begin spraying before the leaves curl, and before the aphids become sufficiently numerous to injure the plants. It will often be found practicable to spray in spots or sections of the field to eradicate or check aphid colonies which later might spread over the whole field, thus forestalling considerable expense and much possible damage.

Clean Culture and the Destruction of Rubbish. As the aphids feed on many weeds, including shepherd's purse, lambs quarters, wild ground cherry, red root pigweed, ragweed, etc., all such weeds should be destroyed both in and around the potato field. As this aphid passes the winter in the egg stage, usually on rose, but often on the stems of weeds, potato vines, etc., all such rubbish should be destroyed, preferably by burning.

Effect of Weather. The weather plays an important part in controlling aphid outbreaks. Heavy rains will doubtless wash many aphids from the tender shoots. Wet weather also favors the growth of fungus diseases, such as *Entomopthora aphidis*. Apparently aphids are apt to be more troublesome in a cold, wet, backward season, and often disappear altogether on the approach of hot weather. The latter, of course, is more favorable to the development of the insect parasites and natural enemies.

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A COCKROACH PEST OF GREENHOUSES.

Pycnoscelus (Leucophæa) surinamensis Linn.

By M. P. Zappe.

This introduced cockroach was first discovered in Connecticut in the greenhouses of A. N. Pierson, Inc., at Cromwell, on March 1, 1911, by Mr. B. H. Walden, assistant entomologist of this Station. At that time the roaches were present under boards and in cracks but were not very abundant. Mr. Pierson informed him that the insects had been present for several years but that they had done no damage. Little attention was paid to them, therefore, until the spring of 1917, when they had become so numerous that they caused considerable damage in some of the houses by gnawing the bark from the stems of the plants as shown on plate XII, b. After trying to poison the roaches with bait containing arsenic, without much success, Mr. Pierson sent specimens to this Station

and asked for advice in controlling the pest. The specimens arrived on April 30, 1917, and, though immature, they were identified by Mr. Walden as *P. surinamensis* Linn. Mr. Pierson wrote in part as follows:

"*They are found chiefly in the rose benches, hiding during the day in* the soil. At night they come up, apparently in great numbers, and gnaw the bark of the rose plants about two inches from the surface of the ground, making a clean job of it."

A visit was made to the greenhouses on May 7th, and these insects were found to be very abundant. They fairly swarmed in the loose soil in the corners of the rose benches, and under loose boards, boxes, pails, etc. They had already done considerable damage to newly-set rose plants and to Easter lilies by gnawing the stems. As still greater damage seemed imminent, if the pest was not soon checked, we undertook to carry on a few experiments with stomach and other poisons in order to determine a satisfactory method of control.

As little has been published in this country about this particular species of cockroach and its status as a possible pest, all available information has been incorporated with the notes of our experiments in this bulletin.

Damage and Habits.

The damage done during the spring of 1917 amounted to several hundred dollars in this one house. The owner had just set young rose plants on benches which had been idle for about four weeks. These were immediately attacked by the young roaches (there were very few adults present at this time) and nearly all of them were girdled at the base, as shown in plate XII, b. When the roaches are full grown they climb up the plants and eat the leaves rather than the bark on the stems. Much damage was also done to Easter lilies. Here the young sprouts from the bulbs, as well as large plants, were attacked. On the larger plants the bark was chewed off the main stem, as shown on plate XIII. In another house they were eating the bark of the stems of poinsettias.

These roaches spend the day in the soil in the benches, in cracks in the boards on the sides of benches, under boards, barrels, in cracks and holes in the walls of the building, etc., wherever it is

dark and there is a chance to hide. A trowelful of soil from the corner of a bench would sometimes contain from 30 to 40 young cockroaches. A small board or shingle left on a bench undisturbed for a few days would shelter large numbers of them. During the day the roaches are rarely seen and when some are uncovered they run for the nearest shelter, or crawl down into the soil if possible. At night they come out to feed and the walks and benches are covered with them. When feeding they do not seem to mind the light from a lantern. In the house where the roaches were most numerous, the benches were low, being right on the ground and known as solid benches; the sides were boarded up, and the boards were full of knot holes and cracks, making ideal places for roaches to hide. Most of the roaches were near the sides of the benches where the soil was not too wet, and where it was not packed down as hard as in the middle; they were very seldom found hiding in the center of the benches.

Distribution.

The present species is circumtropical in distribution, extending its range frequently into subtropical regions. It is abundant in the peninsula of Florida and the Brownsville region of Texas. It has been found established as far north as Jacksonville, Gainesville and Cedar Keys, Florida; New Orleans, Louisiana, and San Antonio, Texas. Elsewhere in the United States the species has become temporarily established in greenhouses and places similarly heated during cold weather. It has been taken in the reptile house of the New York Zoological Society in New York City; also at Rutherford, N. J., Washington, D. C., and Cromwell, Conn. An immature specimen taken from a bunch of bananas has been recorded from Toronto, Ontario.

Professor A. P. Morse of Wellesley College reported it doing damage in a conservatory at Wellesley, Mass., in company with the Australian cockroach, *Periplaneta australasiae* Fabr.

Outside of the United States *Pycnoscelus surinamensis* has been taken in* Cuba,[7] Bahama,[6] Porto Rico,[7] Dominica,[2] Trinidad,[1] Barbados,[11] Martinique,[11] Grenada,[11] St. Vincent[11] and Jamaica[11] Islands of the West Indies, Bermuda,[9] Mexico,[11] Costa Rica,[11] Brazil[11] and Guiana[11] on the American continent, Sumatra,[8] Lom-

* Numbers refer to literature at end of this paper.

bok[4] and Java[11] of the East Indies, Philippine Islands,[11] Lower Siam,[8] Singapore, Straits Settlements,[3] Amoy, Southern China,[11] and Senegal, northwestern Africa.[11]

Probable Manner of Introduction.

This cockroach was probably first brought into Connecticut with shipments of plants or fruit from South or Central America, Florida or Texas. Florists have for many years imported palms, ferns, orchids, and various other tropical plants, and thousands of shipments of pineapples and bananas come each year into the northern states.

No official inspection was made of any imported plants entering the State until 1909 when nests of the brown-tail moth were found on fruit stock grown in France. For three years the larger shipments of stock imported by nurserymen were inspected, but doubtless many small shipments were brought in by private owners, and extensive importations made by florists. These were not inspected because there was no way to trace them. In 1912 the Federal Horticultural Board was established, and its system of permits and notices has made it possible to trace all shipments entering the state since that time. All woody, field-grown plants have been inspected but it has not seemed necessary to attempt the inspection of all herbaceous or tender greenhouse plants, and no inspection of fruits has been attempted.

This cockroach must have entered Connecticut at least as early as 1909, and perhaps earlier, and the chances are good that it came in with plants. Nymphs of this species were intercepted at Cromwell, Conn., in the spring of 1915, on a shipment of Araucarias from Belgium, and it has been found in the District of Columbia with plants imported from Straits Settlements. This and other species of cockroaches have been found frequently by horticultural inspectors in the District of Columbia, New York, New Jersey and Connecticut. In many cases the roaches were immature, and the infestation reported under the name of "cockroach," and the species not identified. Most of the roach infestations have been in shipments of orchids, palms, and araucarias. The greatest number of intercepted specimens have come from Colombia 29, Brazil 8, Venezuela 6, Belgium 1, Guatemala 1, Straits Settlements 1, Azores 1, Antiqua, British West Indies 1, and Philippine Islands 1.

SYNONYMY.

1758, *Blatta surinamensis* Linn. 1838, *Panchlora surinamensis* Guer. 1862, *Pycnoscelus obscurus* Scudd. 1865, *Leucophaea surinamensis* Brunn.

Other established synonyms of the present species are:

Blatta indica Fabr. *Blatta melanocephala* Stoll. *Blatta punctata* Eschscholtz. *Blatta corticum* Serville. *Panchlora celebesa* Walker. *Panchlora submarginata* Walker. *Panchlora occipitalis* Walker.

DESCRIPTION.

Female*

Form robust, structure rather heavy. Head flattened, eyes well developed. Maxillary palpi short and stout. Pronotum with glabrous surface showing minute, rather widely separated pits. Wings transparent except in narrow area of the irregular costal veins and distal portion of anterior field where they are translucent. Styles very short, joints much fused, acuminate tip flattened, dorsal surface weakly convex, ventral surface more strongly convex proximad. This species is easily separated from the other common roaches of North America by having the ventral margins of the femora unarmed, or supplied with few distal spines. Head shining, blackish brown; legs brown; tegmina translucent, blackish chestnut brown. Abdomen with dorsal surface dark brown, ventral surface polished, broadly margined with blackish brown, shading into brilliant, suffused cinnamon rufous in large mesal portion. Pronotum shining, blackish brown, with marginal traces of buffy latero-cephalad. General coloration of immature specimens deep chestnut brown to blackish chestnut brown. Head, pronotum, mesonotum, metanotum, median segment, first two dorsal abdominal segments and ventral surface polished, with very minute, scattered microscopic punctae on head and dorsal polished portions. Remaining dorsal portions of abdomen microscopically finely shagreened, showing raised and polished points on third segment and fewer raised points on the remaining segments. Head of general color shading to slightly paler on the occiput. The female is shown on plate XIV, a.

Eggs.

Eggs are often laid in the soil by the females. When first laid they are whitish yellow, later becoming darker. Egg masses are

* From Blattidae of North America, by Morgan Hebard.

slightly curved as shown on plate XII, c, and vary in size, the larger ones being about 10 mm. long and 3 mm. wide. The embryos in the egg mass are well developed before the eggs are laid and when an egg mass is broken open the young roaches appear to be ready to hatch. The eyes, mandibles and spines on the tibiae are brown and the rest of the body is white. The eggs in each mass vary from 14 to 42 in number, the average being 24.

Egg Laying Habits.

When roaches have been injured, or very much excited, they will often lay an egg mass which as a rule is not very well developed and in the laboratory has never produced young.

A number of adult roaches in a cage were kept at a temperature of about 36° F. for a few days. After a short time they were all on their backs, apparently dead, but when they were removed to a warmer room many of them came back to life and laid quite a number of egg masses. In our experience none of these egg masses or those found in the soil or in the cages have ever hatched. Sometimes a female will eat her own e gs.

Very little is known of the reproduction of this species but from our observations it would seem that normally the young roaches are either born alive or hatch from eggs within 24 hours.

Is the Species Parthenogenetic?

Though the male has been described and occurs in the East Indies, Mr. Hebard* states that he has examined several hundred specimens from the United States, Mexico and the West Indies without finding a single male, adult or immature, from the American continent. Over 1,000 specimens from Mr. Pierson's greenhouses were examined, and all were females. These facts point toward parthenogenesis, but do not prove it.

Control Experiments.

A number of poisons were used in various combinations to control this cockroach, but only a few were found that were of any value at all. Some of them would kill the roaches but not in large enough numbers to pay for the treatment. The object of these experiments was to find a quick and also a cheap way to get rid of this pest. Following is a list of those poisonous baits which

* Ibid. page 196.

under ordinary conditions would hold this insect in check and would be useful in small infestations of this cockroach.

Effective Poison Baits.

PHOSPHORUS PASTE.

This paste is made of flour, glucose, honey, and from 2% to 4% of phosphorus. This comes in two-ounce tubes and may be purchased in nearly all drug stores. The price is 25 cents for a two-ounce tube and would be a very expensive treatment for a large greenhouse. The roaches are very fond of this bait and are easily killed by it. A home-made phosphorus paste was made at the Experiment Station chemical laboratory which worked as well as the commercial paste but it is not recommended for general use. Yellow phosphorus, from which this paste is made, is highly inflammable and must be kept under water. It is, therefore, very dangerous for anyone not acquainted with its properties to handle it. There is also danger from fires if too high a percentage of phosphorus is used in the paste.

BORAX.

This is the next best remedy for this cockroach and has some advantages over the phosphorus paste. It is cheaper, non-poisonous to man, easily handled, and can be used in several combinations. It is slower in its action on the roaches than phosphorus. After eating borax the roaches first lose the use of their legs and may be seen slowly crawling around on top of the soil in the benches or on the walks, and later they die.

A mixture of borax, powdered sugar and cooking chocolate, equal parts of each, ground up together in a mortar and made into a paste with honey and water, was tried and killed many roaches. This was eaten slowly and was not all cleaned up for a week. Dead roaches were found every day and for a few days after the bait was all eaten.

Another formula tried was:

Borax	4 oz.
Flour	4 oz.
Bananas	3.

Three over-ripe bananas, flour and borax were made into a paste and applied to several benches. This was all eaten in a few days and dead roaches found.

A bait made of powdered sugar and borax in equal parts was used with good results. It has the advantage of being easier to mix and apply and is also cheaper than any of the other borax combinations tried. The results were about the same. To a part of this mixture a few drops of anise oil were added to make it more attractive. This was eaten a little sooner than the portion without anise oil. Such was the case whenever anise oil was added to any bait that roaches would eat.

Some of the following poisons were eaten by roaches, and others were not. Those that were eaten were of very little value in holding the insect in check.

STRYCHNINE.

Strychnine........................2 grams.
Wheat bran........................1 pint.
Glucose and water enough to moisten.

The strychnine was dissolved in a little water, the glucose added, and the mixture then used to moisten a pint of bran. Roaches ate this fairly well but very few dead ones were found. This formula was also tried with the addition of a few drops of anise oil with no better results.

Strychnine........................2 grams.
Flour........................1–2 lb.
Sugar enough to sweeten.

This was all eaten and a few dead roaches found.

ARSENICAL POISONS

This species of cockroach seems to be very resistant to the effect of arsenicals. Only a few of the following were eaten at all, and where they were, no dead roaches were found.

Arsenate of lime............10 grams
Flour............1–2 lb.
Sugar to sweeten.

All of this was eaten but no dead roaches were found.

Arsenate of lead......5 grams (dry powdered).
1 over-ripe banana.

This mixture was eaten but no dead roaches were found.

Arsenate of lead, 5 grams, was worked into one-fourth pound of lard. Little red ants began to eat this as soon as it was put down.

The heat in the greenhouse was enough to soften the lard so that it ran all over the paper upon which it was placed. I do not know whether the roaches ate any of this or not, but no dead roaches were seen.

Paris green	4 oz.
1 Orange	
1 Lemon	
Molasses	1 pint.
Middlings	5 lbs.
Water	3 qts.

This formula is recommended for cutworms, but proved to be of no value against this cockroach, as none of the mixture was eaten.

White arsenic	2 oz.
Flour	1 lb.
Sugar	2 oz.

These ingredients made into a thin paste with water were left untouched.

On two benches the stems of the rose plants were painted with a thick solution of lead arsenate. These plants were not injured.

Rose branches—parts of plant cut off when pruning—were dipped in a solution of lead arsenate. Leaves and all were partly eaten every night. After the first night the leaves would be wilted and the roaches would not eat any more of this material.

Arsenate of soda	150 grains
Sugar	2 oz.
Beer	6 fluid oz.
Water enough to make a pint.	

This was used to moisten bran and was placed on benches. I could not tell if this was eaten very much as men watering the plants may have washed most of it into the soil. At this time the men working in this greenhouse used some commercial phosphorus paste at night and many dead roaches were found. Some of these were collected and their stomach contents analyzed by Mr. C. B. Morison of the Chemical Department. He found no trace of arsenic but large quantities of phosphorus. This shows that the arsenic was not responsible for their deaths.

CYANIDE OF POTASSIUM.

Cyanide of Potassium.........1–4 oz.
Flour.........................1 lb.
Sugar to sweeten.

Cyanide was dissolved in a little water and mixed with the flour and sugar to make a thin paste. When this was mixed it smelled very strong of cyanide but the next morning it was all eaten. Even the paper upon which it was placed was devoured, big holes being eaten out where the poison touched it, as shown on plate XIV, b. Cyanide, although a very deadly poison, had no apparent effect on these cockroaches and no dead ones were found.

Flour..............................1 lb.
Cyanide of Potassium...............10 grams.
Arsenate of lead...................10 grams.
Sugar.............................. 2 oz.
Water to make a thin paste.

In this case cyanide and arsenate of lead were used together and the mixture was all eaten by the roaches, but no dead ones were found.

Flour........................1–2 lb.
Cyanide.....................1–4 oz.
Phosphorus (Red)............1–2 oz.
Glucose......................2 tablespoonfuls
Water to make a thin paste.

This, like the preceding, was all eaten, but did not kill the roaches.

RED AMORPHOUS PHOSPHORUS.

Flour........................1–2 lb.
Red Phosphorus..............1–2 oz.
Glucose......................2 tablespoonfuls
Water to make a thin paste.

The phosphorus used in this formula is poisonous but is not dangerous to handle like the yellow phosphorus. It has the characteristic phosphorus smell and was thought to be a good substitute for the phosphorus paste. The cockroaches ate this bait but it did not kill them.

Lard......................1-4 lb.
Phosphorus (Red)..........5 grams.

This was mixed and spread on pieces of paper but the heat in the greenhouse made the lard soft and it began to run. Ants immediately began to feed on this mixture. I do not know whether roaches ate any of this or not but no dead ones were found.

MERCURIC CHLORIDE.

Mercuric Chloride............10 grams
Flour........................1-2 lb.
Glucose......................1 tablespoonful.
Water to make a soft paste.

This formula was tried, one-half with a few drops of anise oil, and the other without, but the roaches would not eat it.

PLASTER OF PARIS.

Plaster of Paris ....1-2 lb.
Flour........................1 1-2 lb.
Powdered sugar..............1-4 lb.

These ingredients were mixed dry and were placed in shallow flower pots where the roaches could get at it. Dishes of water were placed near the bait, the idea being that the roaches would eat the bait and drink the water, and the plaster of Paris would set in their stomachs, thus killing them. The roaches did not eat any of this mixture but sowbugs did, although no dead ones were found.

REPELLENTS.

Sawdust was moistened with fish oil and sprinkled around the plants where the roaches had been doing the most damage. This kept them away from these plants for a few nights, but when the plants were watered the sawdust was washed away and the mixture lost its usefulness. Sawdust and kerosene was also tried with about the same results as the above except that any roaches that came in contact with the kerosene were killed.

TRAPS.

Large glass jars baited with stale beer were sunk into the benches almost to the level of the soil. These worked fairly well but cannot be considered as effective traps, as the roaches were

not caught in large enough numbers. For small infestations they would perhaps be satisfactory but in this case it was too slow a method of control.

KEROSENE SPRAY.

Our experience with kerosene as a repellent led us to try it as a contact spray. Pure kerosene sprayed along the top and sides of the benches brought out all the cockroaches which were near the sides and surface of the benches. As this is the place where most of the roaches stay during the day, great numbers of them were killed in this way. On one side of one bench, in spraying only four feet in length of the bench, 184 roaches were killed. In one corner of the house where the masonry was broken there were many holes in which the roaches hid during the day. Kerosene was sprayed into these holes and the roaches came tumbling out. When they came in contact with the oil they were all killed and the ground was literally covered with dead roaches.

Kerosene will burn the foliage, so great care must be taken not to get any spray on the leaves of the plants. The owner of the greenhouse used the treatment and so reduced the numbers of the roaches that there was no longer any danger of their doing serious damage to his plants.

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ERADICATING THE LITTLE HOUSE ANT OR PHARAOH'S ANT FROM A DWELLING HOUSE.

By M. P. Zappe.

A serious outbreak of the little house ant or "Pharaoh's ant" was reported by a family in Hartford late in November 1916. This ant had been present in this house for several years but had not caused much annoyance until the summer of 1916. In other years it had confined its activities to the pantry and kitchen, and at the beginning of cold weather would disappear until the following summer. But this year the ants were running all over the house, no part of it being free from them. At this time there were many queens around the house, as well as worker ants. A favorite place was the bathrooms, where they could be seen drinking water and running along the tile floor. There were ants in every room in the house; a few could be found on tables, writing desks, among clean clothing in bureaus, on the floors, walls, etc. The lady of the house had been fighting them all summer and was on the verge of a nervous breakdown. She was willing to do almost anything to get rid of this pest, even threatening to tear the house down.

Naphthalene flakes had been used but its effect was only local, merely driving them out of the room where it was used. The family objected to the smell of naphthalene so it could not be used all over the house. Trapping with a sponge dipped in a sweetened solution, and when full of ants, dropping it into hot water, killed many ants but they soon became suspicious of the sponges, after which very few would venture to go into them.

On December 1, 1916, a poisoned bait recommended by the Bureau of Entomology, Washington, D. C. (Farmers' Bulletin 740) was tried. The formula for its preparation is as follows:

1 lb. .... sugar
125 grains .... arsenate of soda
1 qt. .... water
1 tablespoonful .... honey.

Dissolve sugar in the water and add the arsenate of soda. Boil until sugar and poison are all dissolved, then add the honey. The addition of the honey is said to make the bait more attractive to the ants. When cool this mixture was used with bits of sponge on small, shallow dishes and two or three dishes placed in each room. The object of this poisoned bait is not only to kill the ants

which collect and carry the sirup back to the nests, but also the young and the queens in the nest which feed on it. In less than two hours after distributing the poison around the house, the ants began to find the bait and large numbers were feeding on it and carrying it back to the nest. Even the queens were seen at this bait. A few days later another batch of bait was made up, but this time either it was boiled too long or too much honey was added. When it cooled it was too thick for the ants to eat readily. On December 6 the same formula was tried again except that *only one-half* pound of sugar was used. This made a thinner sirup which did not dry and harden as quickly as the sirup made from one pound of sugar. The ants seemed to eat this better than the thicker sirup. At this time there seemed to be fewer ants in the front of the house but just as many in the kitchen, where no poisoned bait was used.

The house was visited again on December 15 and very few ants were found on the first floor. A few were found in the bathrooms of the second floor where they were drinking water from the toilets and washbowls. Oxalic acid has been recommended as a remedy for ants by some writers. This was tried in combination with lard but the lard and acid did not mix, so lard was melted and the acid added. This stayed mixed until cool; then it separated. Ants did not eat any of the mixture.

On December 18 no ants could be found on the first and second floors. Two bathrooms on the third floor had a few living ants and many dead and dying ones were curled up on the floor. A poisoned bait of beef liver (2 oz.) and potassium cyanide (150 grains) was made up by chopping the liver fine and adding the cyanide in a water solution. There were so few ants left that we could not tell whether they ate any of this or not. Early the following spring (March 23) the house was visited again but no ants had been seen in the house since December 18, when the last poisoned bait was used. A recent letter states that the ants have never returned, much to the joy of the family.

A NEW FRUIT PEST IN CONNECTICUT.

Laspeyresia molesta Busck.

On July 11 specimens of peach shoots were received from Mr. C. C. Lawrence of the F. A. Bartlett Company, Stamford, who wrote as follows:

"Am sending you under separate cover some specimens of peach twigs, the terminal shoots of which have been attacked by a small insect. Very possibly this may be due to the peach twig borer but the color of the larva is such as to suggest that it might be *Laspeyresia molesta*, brought over from Japan and reported by Dr. Quaintance. In talking with Dr. Quaintance this spring, he mentioned the fact that it had not been found outside the District of Columbia, Maryland and Virginia. Do you suppose it is this insect?"

The specimens were examined and the letter answered by Mr. Lowry as follows:

"Your letter of July 10th, also the package containing the peach twigs, have been received in the absence of Dr. Britton. The twigs were quite badly crushed and it was possible to obtain only one larva. If you would be so kind as to send us more material in a box, it would be greatly appreciated. As you suggest, the damage is probably caused by the larva of *Laspeyresia molesta*."

Specimens were sent to the Bureau of Entomology by Mr. Lawrence or his firm and the insect was identified positively as *Laspeyresia molesta*. Mr. E. H. Siegler of the Bureau, in company with Mr. F. A. Bartlett, visited several orchards in the vicinity. They found the insect not only in Stamford but also in Norwalk near the border of New Canaan, in the twigs of a bearing peach orchard. Though a nearby nursery was examined, no trace of the insect could be found on nursery stock. The assistants engaged in inspecting nurseries were instructed to be on the watch for this pest, but they did not find it anywhere during the progress of their work.

As this insect is new to Connecticut, and was described in 1916 as being new to science, a brief account of it is given here, taken chiefly from Quaintance and Wood.* The following description from their paper is reproduced here:

Full Grown Larva. "Thirteen to fifteen mm. long; whitish suffused with pink; tubercles minute, black. Head light brown with darker brown markings; hind margin, ocellar area, and the tips of the trophi black. Thoracic shield light yellow, edged with brown. Spiracles small, circular, dark brown. Anal plate blackish fuscous. Legs and prolegs normal."

* Journal of Agricultural Research, Vol. VII, page 373, November 1916.

The adult has a wing-spread of about half an inch, and belongs to the family Tortricidae. The following is the original description by Mr. Busck:

Adult. "Head dark, smoky fuscous; face a shade darker, nearly black; labial palpi a shade lighter fuscous; antennae simple, rather stout, half as long as the forewings, dark fuscous with thin, indistinct, whitish annulations. Thorax blackish fuscous; patagia faintly irrorated with white, each scale being slightly white-tipped. Forewings normal in form; termen with slight sinuation below apex; dark fuscous, obscurely irrorated by white-tipped scales; costal edge blackish, strigulated with obscure, geminate, white dashes, four very faint pairs on basal half and three more distinct on outer half besides two single white dashes before apex; from the black costal intervals run very obscure, wavy, dark lines across the wing, all with a strong outwardly directed wave on the middle of the wing; on the middle of the dorsal edge the spaces between three of these lines are more strongly irrorated with white than is the rest of the wing, so as to constitute two faint and poorly defined, white dorsal streaks. All these markings are only discernible in perfect specimens and under a lens; ocellus strongly irrorated with white, edged by two broad, perpendicular, faint bluish metallic lines and containing several small, deep black, irregular dashes, of which the fourth from tornus is the longest and placed farther outward, so as to break the outer metallic edge of ocellus; the line of black dashes as well as the adjoining bluish metallic lines are continued faintly above the ocellus in a curve to the last geminate costal spots; there is an indistinct, black apical spot and two or three small black dots below it; a thin but distinct, deep black, terminal line before the cilia; cilia dark bronzy fuscous. Hind wings dark brown with costal edge broadly white; cilia whitish; underside of wings lighter fuscous with strong iridescent sheen; abdomen dark fuscous with silvery white underside; legs dark fuscous with inner sides silvery; tarsi blackish with narrow, yellowish white annulations."

INJURY.

The larvae have been found injuring the twigs not only of the peach, but of the plum and cherry, and also the fruit of the peach. In one orchard between 80 and 90 per cent. of the twigs had been injured, and adjacent nursery stock showed even a higher percentage of injury. This injury begins soon after new growth starts in spring and continues until growth ceases in the fall. The larvae seem to prefer the tender growing shoots, and may pass from one into another. Thus one larva may tunnel and injure several shoots. The injury to twigs closely resembles and is scarcely distinguishable from that caused by the common

peach-twig borer or peach moth, *Anarsia lineatella* Zell. Apparently the peach is preferred to the plum and cherry. This twig injury checks growth and on the peach is followed by an exudation of gum; it is more serious in a nursery than on bearing trees.

Though considerable injury results from the attack to the twigs, it is the attack on the fruit of the peach which causes the greatest damage. The larvae eat through the skin near the stem, beginning their attack on the green fruit, but as the fruit approaches maturity it becomes more seriously infested. Ripening peaches often have several larvae in a single fruit, and following the mutilation, brown rot finishes the destruction. The larvae will also enter the fruit at other places, especially if damaged by hail or punctured by curculio. Many of the infested peaches fall to the ground, but some will hang upon the tree. Since this article was written it has been discovered that the larvae infest not only peach but also the fruit of apple, pear and quince.

Life History.

The winter is passed by the full-grown larva on the tree, probably making winter cocoons in the cracks of the bark or in cavities eaten into the bark on the twigs. Early in the spring the larva enters the pupa stage. In summer, cocoons are sometimes made in the cavity at the stem end of the fruit. The cocoon is made of whitish silk. There are probably two or three broods of larvae each year. The adults emerge and begin to lay eggs soon after growth starts on the tree, as larvae have been observed at work on the twigs when the new shoots were from six to eight inches long. Thus the larvae begin early in the season and they are found in different stages at work on the twigs until late in the fall.

Possible Control Measures.

It is too early to recommend control measures, as experiments have not yet been conducted to determine the best methods of treatment. Only a few possible measures can be pointed out here. The cocoons and larval cases are so close and impervious that fumigation with hydrocyanic acid gas does not seem to be a satisfactory remedy. Possibly dipping the trees in a miscible oil may prove more effective. This can easily be carried out when the trees are dug for shipment.

In the bearing orchard early spraying with lead arsenate soon after the fruit sets will probably reduce the injury to the fruit, as in the case of the codling moth which attacks the apple.

The larvae tunnelling in the twigs are mostly out of the reach of arsenical poisons. Clipping off the twigs in winter—a customary practice in heading back orchard trees—will undoubtedly remove a small percentage of the larvae. These twigs should be gathered and burned before the trees start into growth.

THE FALL WEB-WORM.

Hyphantria cunea Drury.

Nearly every year in the latter part of the summer nests of the fall web-worm are present on orchard, shade and woodland trees throughout the State. These are more prevalent in some seasons than others, and it is, of course, when most abundant that the insect is the most destructive. In 1901, the fall web-worm was exceedingly prevalent. It continued to be abundant through 1902 and 1903, though diminishing somewhat. From then until the present, the nests have not been rare, though not sufficiently common to receive particular mention in the annual report of this Station. In 1916 this insect was noticeably more common than for several years preceding, and in 1917 it was probably more prevalent than since 1902. As no adequate account of this insect has ever been published in this series of reports the present paper was prepared to supply the want.

Relationship to Other Insects.

The fall web-worm is the larva of a moth belonging to the family Arctiidae or tiger moths. Most writers consider it to be *Hyphantria cunea* Drury, but some recognize it as *H. textor* Harr., while others consider the two species as identical, *textor* being a synonym, or possibly a variety of *cunea*. The Station collection contains one adult specimen labeled *textor*, and all others are labeled *cunea*. The writer has made no attempt to separate the two species. For the purposes of this article it really makes no difference. In Smith's List of Lepidoptera, 1st edition, published in 1891, *textor*, *punctatissima* and several other names are given as synonyms of *cunea*. In the 2nd edition, published in 1903,

and also in Dyar's List of Lepidoptera, published in 1902, *cunea* and *textor* are given as separate species. In the recent Check List of Lepidoptera by Barnes & McDunnough, they are also given as distinct species.

Dr. E. P. Felt* states that "the web made by the larva of the more common species in this state (New York) belongs to *Hyphantria textor* Harris" and that *cunea* may also occur "but appears to be rarer than the other species." In Banks' Index of American Economic Entomology, the references are given under *cunea*. As most of the references in literature have been given under the name of *cunea*, this name is used in the present paper.

Injury and Habits.

The caterpillars injure trees of nearly all kinds by feeding upon the leaves, often defoliating them. The nests or webs usually occur on the ends of the branches. In this respect the fall web-worm differs from the tent-caterpillar (with which it is sometimes confused), which makes its nests in the forks of the main trunk or branches. The latter insect makes its nests in May and those of the fall web-worm appear in July, August and September. Moreover the tent-caterpillars go out of their nests to feed, and the fall web-worms always feed inside their nests, as shown on plate XVII, b. When the leaves have been eaten, they extend their nests to include fresh leaves and proceed to devour them. In this way the nest may become so large as to involve the whole branch. All caterpillars hatching from a single egg-cluster probably live and feed together in one nest.

When fully grown the caterpillars leave their nest and crawl about seeking a place to transform. They are then from one to one and one-half inches in length and are covered with brownish hairs. The hickory tree shown on plate XVIII was entirely defoliated by fall web-worms in New Canaan in 1901.

Food Plants.

Some years ago the Bureau of Entomology of the U. S. Department of Agriculture at Washington, D. C., compiled a list of food plants containing 120 different kinds of trees, shrubs and plants, upon which the caterpillars feed. This includes nearly

* Insects Affecting Park and Woodland Trees, i. page 143, 1905.

all the fruit, shade, ornamental, and native woodland trees. Pear, apple and cherry are commonly attacked. Elm, willow, poplar, hickory, black walnut, black cherry, choke cherry, ash, box elder and hackberry are common food plants, often being wholly or partially defoliated. We may therefore expect to see this insect on almost any kind of tree or shrub grown in the State.

Number of Broods.

There is usually but one brood each season in Connecticut, the caterpillars appearing in late summer. In 1904, the writer observed one of the nests in New Haven, June 23, and rearing adults, found that they laid eggs and that a second brood of caterpillars had hatched by August 15. These caterpillars were fed until nearly full grown, but as all members of the staff were obliged to be away inspecting nurseries, they were not fed and all died from starvation before transforming. This indicates that the fall web-worm is partially double-brooded in Connecticut. Since 1904, an occasional nest has been noticed in early summer, but most of them are seen later in the season.

Beutenmüller* states that this insect is double-brooded in the vicinity of New York City, and Smith† records two broods as being normal in New Jersey. According to Dr. Howard,‡ there are two broods in Washington, D. C. On the other hand, Fernald has studied the life history of this insect carefully in Massachusetts and finds only one annual brood in that latitude.

Life History.

The adult female lays on the under side of a leaf a cluster containing between 400 and 500 eggs. This cluster is shown on plate XVI, b. The eggs hatch in about ten days and the caterpillars feed gregariously and form a nest on the end of the branch. In about six weeks they become full-grown and pupate under rubbish, or attached to fences, tree trunks, etc., in light-brown cocoons covered with the hairs from the caterpillars. The principal or late brood passes the winter in these cocoons. Where

* Bulletin, American Museum of Natural History, Vol. X, page 376, 1898.

† Insects of New Jersey, page 439, 1909.

‡ Farmers' Bulletin No. 99, U. S. Department of Agriculture, page 20, 1899.

there are two broods the adults emerge in May, but in the north where the insect is normally single-brooded the adults do not appear until July. Where double-brooded, the first-brood caterpillars transform to pupae about July 1st and the adults emerge about a month later.

DESCRIPTION.

Egg. 0.55 mm. in diameter, globular. Surface finely sculptured or pitted. Light green or yellow when first laid, changing to a lead color before hatching. Laid usually on the under side of a leaf in a cluster containing from 400 to 500 eggs, covered with whitish hairs from the body of the female.

Larva. When first hatched, pale yellow with two rows of dark tubercles along the back, these tubercles bearing hairs. When fully grown from 30 to 35 mm. in length; color variable. Mostly striped with dark brown or black and yellow. Some individuals are nearly solid brown, some nearly black, while others are gray or lead color. There are two rows of black and orange dorsal tubercles bearing hairs which are mostly light brown but some are nearly black and others white. These tubercles are really part of a series of transverse rows, one row being borne on each segment, and, except ventrally, surrounding it. The tubercles all bear hairs nearly uniform in length, giving the caterpillar a distinctly hairy appearance. Head and legs vary from light brown to black.

Pupa. 8-10 mm. long, brown, with a more or less distinct swelling near the middle and with the spiracles showing as projections along the sides. Enclosed in a thin, light gray cocoon, in which larval hairs and particles of dirt are mixed. The cocoons are usually formed in clusters in the crevices on trunks of trees, underneath fences, rubbish on the ground, etc.

Adult. Wing-expanse 25-35 mm. Front and rear wings white, the front wings either pure white or more or less well-marked with black spots. In the most prominently marked specimens these spots form six curved transverse rows; this form has been described as *punctatissima*. The immaculate form has been described as variety *budea* Hübn. There are all gradations between these two forms. The rear wings often have one or more black spots but many are immaculate. Femora yellow, tibiae black. Eggs, adult and small larvae are shown on plate XVI.

Parasites and Natural Enemies.

No doubt some of the birds, like cuckoos, shrikes, etc., which commonly attack hairy caterpillars, feed upon the fall web-worm. Perhaps the most important natural enemies are the four-winged or parasitic flies belonging to the order Hymenoptera. Of these, three of the most important are *Apanteles hyphantriæ* Riley, *Meteorus hyphantriæ* Riley, and *Campoplex* (*Limneria*) *pallipes* Prov. An egg parasite, *Telenomus bifidus* Riley, is said to sometimes destroy nearly all eggs in the cluster. In addition to the parasites mentioned above, the following have been reared from this or some other species of *Hyphantria*: *Campoplex fugitivus* Say, *Apanteles lacteicolor* Viereck, *Pteromalus* (*Dibrachys*) *boucheanus* Ratz., *Syntomosphyrum esurus* Riley and *Eremotylus glabratum* Say. A dipterous parasite of the family Tachinidae, genus *Tachina*, has been recorded by Dr. C. V. Riley*, who states that this fly is fully as useful as any of the other insect parasites.

In addition to the parasites, there are several predaceous insects that devour the larvae. These include the soldier bugs, *Euschistus servus* Say and *Podisus maculiventris* Say, in the Southern States the praying mantis, *Stagmomantis carolina* Linn., and the wheel bug, *Prionidus cristatus* Linn., and the larva of a Carabid beetle, *Plochionis timidus* Hald. The adult moths are eaten by various species of birds, spiders, dragonflies, robber flies, and the large ground beetle, *Calosoma scrutator* Fabr.

In Kentucky in certain years the caterpillars are killed by a fungus, *Empusa gryllii* Fres.

Control Methods.

There are two common methods of controlling this insect on orchard and shade trees, but in the woodlands there has been no attempt to combat it. On small trees that can easily be reached, it is a simple matter to clip off and burn the nest when first formed and small, before the tree has been injured. Tree pruners can be used for this purpose on larger trees. It is also feasible to kill the caterpillars in their nests on the tree by means of a torch. This will not seriously injure the tree as might be

* Bulletin No. 10, Division of Entomology, U. S. Department of Agriculture, page 52, 1887.

the case with the tent-caterpillar, where the nests are in forks of the branches. Fall web-worm nests are at the ends. The use of the torch will scorch some of the nearby leaves as well.

Spraying with lead arsenate, using at least three pounds of the paste (or one and one-half pounds of the powdered or dry form) in a barrel containing fifty gallons of water, will prevent any serious or marked defoliation of the tree. This is, of course, the method generally practiced in Connecticut orchards, which need to be sprayed systematically in order to obtain good fruit. Shade trees can also be sprayed, and are sprayed in many Connecticut towns and cities. The expense of spraying woodland would be prohibitory. Certain small areas are sprayed each year in gipsy-moth infested regions in the eastern part of the state, and of course the spraying effectually controls the fall web-worm.

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THE HICKORY TUSSOCK MOTH, *HALISIDOTA CARYAE* HARRIS, AND OTHER CLOSELY ALLIED SPECIES.

The report of this Station for 1907, contained on page 332 a brief notice of the hickory tussock moth, and illustrations were given on plate XV. During the past ten years this insect has had its ups and downs, but in 1917 it seemed to be more abundant than for many years. Late in the summer the caterpillars were seen crawling about on walks, fences, trunks of trees, etc., seeking a place to pupate. Associated with the hickory tussock moth caterpillars were the caterpillars of the white-marked tussock moth and many larvae of the tessellated tussock moth, *Halisidota tessellaris* S. & A. The latter is not as common normally in Connecticut as *caryae* but in some localities in 1917 it approached it closely in abundance. The larvae of both species are shown on plates XIX and XX. Plate XX, c, shows the cocoons, probably of both species, on the trunk of a sugar maple tree growing along one of the streets in New Haven.

These tussock moths belong to the family *Arctiidae* and are closely related to the fall web-worm described on page 322 of this report. There are three species in Connecticut: *Halisidota caryae, H. tessellaris* and *H. maculata.* Though the first two are fairly common, *maculata* is rather rare about New Haven but is said to occur more abundantly farther north. *Maculata* feeds on willow, poplar, alder and oak; *caryae* feeds on oak, elm, maple, hickory, walnut, poplar, willow, ironwood, hornbeam, chestnut, linden, locust, apple, cherry, larch, etc.; *tessellaris* is known to feed upon maple, oak, elm, beech, June berry, locust, hornbeam, hickory, walnut, ash, sycamore, witch-hazel, huckleberry, chestnut, willow, poplar, tulip tree, sweet gum and linden. It will be seen from the list given above that these tussock moths are somewhat general in their feeding habits and it would not be strange to find them devouring almost any kind of foliage.

The adults of all three species appear in June and July and the females lay their eggs on the under side of the leaves of their host trees. The hickory tussock moth deposits eggs in a patch about an inch broad. The young larvae feed gregariously at first and greatly resemble those of the fall web-worm, but as they increase in size they take on characteristic markings with each moult. Next to the last instar, they are covered with white hairs prettily

ornamented with black spots, and with two pencils of black hairs near each end of the body, as shown on plate XIX, b. In the last caterpillar stage, just before pupation, there is a continuous black stripe along the back with the black pencils as described above. The caterpillar is then about one and one-half inches long, and is shown on plate XIX, b.

The caterpillar of the tessellated tussock moth varies from gray to yellow, and does not have such a prominent black stripe along the back. On the second segment back of the head, there is on either side a lateral black pencil with two white ones under it. On the third segment there is a similar black pencil with one white one under it. This larva is about one and one-fourth inches long and is shown on plate XX, b.

The adults of both species are about the same size, and have a wing-expanse of about two inches. *Caryae* has light brown fore wings marked with silvery white spots; rear wings nearly white, being light brown or yellowish. Body buff or light brown. *Tessellaris* has both wings of nearly the same color, light brown, semi-transparent. The fore wings are marked transversely with inconspicuous blocks of darker color; rear wings without markings. Body buff or light brown. *Maculata* resembles *caryae* but has light brown instead of white markings on the fore wings.

The cocoons are ash gray and are formed on the trunks of trees, sides of buildings, fences, walls, etc. There is only one brood each year and the winter is passed in the cocoon.

A description of all stages, and illustrations of the white-marked tussock moth (*Hemerocampa leucostigma* S. & A.) will be found in the Report of this Station for 1916, page 105.

Wherever these tussock moths become so abundant as to defoliate trees, the remedy is to spray with lead arsenate, using three pounds of the paste in fifty gallons of water. Properly sprayed orchards will not be injured. In addition to spraying with poison, the caterpillars can be killed when found, and the cocoons can be removed from the trunks of trees during the winter months.

THE WALNUT CATERPILLAR.

Datana integerrima Gr. & Rob.

This caterpillar feeds in clusters on black walnut, butternut and hickory, often defoliating trees, and was particularly abundant

in the State in 1917. It has been mentioned in preceding reports of this Station as follows: 1901, page 275 (brief note); 1905, page 257 (bare mention); 1906, page 298 (bare mention); 1914, page 191 (brief note with one illustration); 1916, page 140 (brief note). The purpose of this article is to give a more extended account of the insect so that property owners and caretakers will recognize it. Several times this insect has been reported to the Station as being the gipsy moth.

On August 16, the entomologist was called to Clintonville, where several black walnut and hickory trees were being defoliated. One large black walnut was about half stripped and the leaves were fast disappearing. Nearly every branch contained one or more clusters of caterpillars, all eating away on the leaves. A small tree of the same kind nearby had been wholly stripped. Hickory trees along the road not far away were also infested, some branches being then denuded.

Caterpillars were received on black walnut from Meriden, August 10; East Haven, August 13; Wethersfield, August 29; and on hickory, Wethersfield, August 30.

The caterpillars are gregarious and may be seen feeding in clusters near the ends of the branches. When full grown they are about two inches long, black, and covered with whitish hairs. The appearance of a single caterpillar is shown on plate XXI, b. Just before pupating the caterpillars separate and crawl up and down the trunks of the trees and along the ground. One often sees them crossing the highway and wonders where they are going; probably either seeking more food or a place to pupate.

Before reaching maturity these caterpillars have the habit of congregating in masses on the trunk or larger branches for the purpose of moulting. The discarded skins remain on the tree making a patch of fur, as shown on plate XXI, d. All larvae of the genus *Datana* are gregarious, and when disturbed elevate their heads and tails in a characteristic and peculiar manner, as shown on plate XX, d. The chrysalid is a naked brown pupa formed in the ground where the species passes the winter. There is only one brood each year.

The adult is a tan-colored or reddish-brown moth with a wing-spread of about two inches. The forewings are crossed with more or less distinct lighter and darker bands. A patch on the thorax is of a beautiful and brilliant mahogany red. The adult, natural size, is shown on plate XXI, a.

Though this insect is not of tremendous economic importance, it is conspicuous and people wonder what it is. Moreover, it works very rapidly and the trees attacked are soon stripped; but this stripping, coming as it does so late in the season, does not seriously impair the vitality of the trees, which may put out leaves the next season as if nothing had happened. Of course it makes the trees unsightly and if followed year after year would soon weaken, and perhaps finally kill them.

Spraying the foliage with lead arsenate at the usual strength will prevent injury or will kill the caterpillars which feed upon the leaves.

The caterpillar is parasitized by a small, four-winged fly, *Meteorus communis* Cresson.

As these caterpillars are conspicuous and feed in clusters on the branches, they can easily be removed and destroyed, especially on small trees within reach of the ground. The masses of moulting caterpillars can also be crushed.

THE YELLOW-NECKED CATERPILLAR.

Datana ministra Drury.

Closely allied to the walnut caterpillar, but differing from it by being more distinctly yellow and striped, is a species common on apple, especially young trees, in August and September, known as the yellow-necked caterpillar, *Datana ministra*. This caterpillar, like the walnut caterpillar, feeds gregariously, each egg-cluster hatching into a colony. The caterpillars continue to feed together until they strip their branch or tree and seek more food, or until they moult or transform to the pupa stage.

The yellow-necked caterpillar was very abundant in 1917, and we found colonies in nearly every nursery where apple stock is grown. In newly-set orchards, it always appears and alarms the owner by proceeding to strip some of his choicest trees. It occasionally feeds upon other kinds of trees. Thus on August 9, we received specimens on cherry from New Britain; on apple from Southbury, August 10; Durham, August 15; New Haven and Hamden August 16, on willow, Stonington, September 10. Assistants from this office observed it in Ellington, Manchester, Durham, Wallingford, New Haven, New Canaan, and probably in many more towns when inspecting nurseries.

When fully grown the caterpillar is about two inches in length, striped lengthwise with yellow and black, the stripes being nearly equal in breadth, except for a broader black stripe along the back. Head and legs black and shining. An orange-yellow cross band next the head doubtless gives this caterpillar its name. The body is sparsely covered with rather short and weak light-colored hairs; it does not have the distinctly hairy appearance of the walnut caterpillar nor does it leave hairy patches on the trees where moulting takes place. Like the walnut species, however, when disturbed it elevates head and tail and would thus be recognized as a *Datana*. The adult closely resembles that of the walnut caterpillar and only specialists can separate them. Larvae and adults of both sexes are shown on plate XXII. There is only one generation each year, and it is as a cocoon in the ground that it passes the winter. Apparently this species is not strongly parasitized but *Apanteles lacteicolor* Viereck and *Heteropelma datanæ* Riley have been reared from *Datana* and may be expected to attack it.

What has been said of injury and control measures relating to the walnut caterpillar applies also to this species, except that on one's pet apple trees in the orchard the caterpillars are sooner noticed, and the discovery is made with greater alarm. But here, also, as it is chiefly young trees that are attacked, it is easier to remove and destroy the colonies. Spraying also would be easier on young and small trees. By no means should young orchard trees be allowed to become stripped. In order to make a good orchard, all trees should be kept free of pests and constantly growing and thrifty. Stripping will check their growth if it does not greatly weaken them, and to permit it is indefensible. All such trees should be sprayed each year with lead arsenate, and a close watch should also be kept, and if a colony of these caterpillars be noticed, drop all other work until the pest has been eradicated.

THE RED-HUMPED CATERPILLAR.

Schizura concinna S. & A.

Belonging to the same family (Notodontidae) as the walnut caterpillar and the yellow-necked caterpillar, but to a different genus, is another peculiar and characteristic defoliator of young

apple trees in late summer, known as the red-humped caterpillar, *Schizura concinna*. This name was given it because the prominent fourth segment from the head is bright coral red in color, as is also the head. The body of the caterpillar is narrowly striped lengthwise with orange, brown and white. Nearly all the segments bear short and rather stout black spines or protuberances projecting upward on the back. These are longest in the vicinity of the "hump" or fourth segment. Length about one and one-half inches.

The adult moth has a wing-spread of about one and one-half inches. The female is not conspicuously marked but both front and rear wings are grayish brown, the fore wings shading costally into a lead gray with small apical black spots. The male is much more prominently marked, the fore wings being brown and cream, with a shading of gray on the front margin, especially near the apical spots. The rear wings are cream with a black spot near the anal angle. Body of both sexes gray. Both larvae and adults are shown on plate XXIII. There is one generation each year, the insect hibernating in a slight cocoon under rubbish on the ground. This insect is perhaps less common than the yellow-necked caterpillar, and though it feeds gregariously, the caterpillars do not form such conspicuous clusters on the twigs. They do not elevate their heads when disturbed, like *Datana*, but their tails are elevated all of the time when they are feeding and crawling about. Like the yellow-necked caterpillar, this species is found upon young apple trees in nurseries and in newly-set orchards, but is by no means confined to the apple. It may feed upon almost any plants of the family Rosaceae.

The caterpillars are parasitized by an ichneumon or four-winged fly, *Campoplex* (*Ameloctonus*) *oedemisiae* Ashmead, which was reared in Connecticut from larvae collected at New Canaan, September 22, 1905, by B. H. Walden. Parasitized larvae are shown on plate XXIII, b. Spraying with lead arsenate is the remedy unless destroying by hand can be practiced.

SOME INSECTS INJURING STORED FOOD PRODUCTS IN CONNECTICUT.*

The importance of growing more food for the people of this

* This paper was published as Bulletin 195, and distributed in August. It is here reprinted with appropriate emendations.

country cannot be over-emphasized, and the various efforts along this line and the publications giving information regarding methods are all praiseworthy. Nevertheless, it is perhaps equally important to conserve the food supplies already grown and stored. It has been estimated that insects take an annual toll of about five per cent. of the value of the stored food products, amounting to $200,000,000.00 each year, in the United States. Most of this loss is wholly preventable if attention is given the matter at the right time, and there is no time when control methods can be enforced with greater profit to the owner, or with greater benefit to our country and to mankind than the present.

The object of this paper is to place before the people of Connecticut a brief account of the principal insects attacking and injuring stored grains and food products in the state, and to suggest methods of controlling them. The accompanying plates are for the purpose of illustrating the text and of giving an idea of the general appearance of the insects.

These insects belong in two large natural groups: the Beetles (Coleoptera) and the Moths (Lepidoptera). The principal features of each are given to enable the reader to identify the species, but as control measures are similar for all, information on this point is given in a separate chapter on page 339 of this report.

THE GRAIN BEETLES.

The Common Meal Worm, *Tenebrio molitor* Linn.

In and around the bottoms of bins and barrels where corn meal, flour, or other cereals are stored, one often finds yellow larvae about an inch in length and resembling wire worms. These feed upon the meal and are called meal worms.

The adult is a shining, black or dark brown beetle, somewhat more than half an inch in length, with thorax rather finely punctured and wing-covers longitudinally striated or grooved. The beetle lays its white eggs in the meal, usually in masses, with a juice or sticky material which causes the meal to adhere to the eggs. The eggs hatch in about two weeks and the larvae feed upon the meal for three months or longer before pupating. The pupal stage requires about two weeks, and normally there seems to be but one generation each year. The adults mostly emerge

in the spring, but where the meal is stored in the house, or in a heated building, they may appear at any time of the year. This insect is shown on plate XXIV, b.

The Darker Meal Worm, *Tenebrio obscurus* Fabr.

This insect is much like the preceding except that the larvae are darker in color and the adult beetles are dull instead of shiny. The life history and injuries are similar and both often occur in the same place.

The treatment is also the same for both species, *viz.*: fumigating with carbon disulphide or heating the meal in an oven for a short time.

The Cadelle, *Tenebrioides mauritanicus* Linn.

The larva of this beetle is dirty-white, with head, prothorax and tip of abdomen dark brown, and when fully grown it measures about three-fourths of an inch in length. It has the habit of tunneling into wood to make its cocoon, at least when soft pine is available. The pupa stage evidently lasts three or four weeks.

The adult beetle is brown and shiny, and about three-eighths of an inch long. It lays white eggs which are a trifle over a millimeter long and one-fourth as thick.

There is a single generation annually, and the cadelle feeds on various kinds of stored foods and plant products and is also partially predaceous, as Chittenden* states that both larvae and adults attack and destroy other grain insects which they encounter. Nevertheless, the cadelle is capable of causing considerable injury and the treatment is the same as for the other meal worms. The larvae of the cadelle have been reported from many unexpected places, such as in sugar, in bottles of milk, in powdered hellebore, and boring through the parchment paper of jars of jams and jellies. In some of these places they probably occurred accidentally. Larva and adult are shown on plate XXIV, d.

The Pea Weevil, *Bruchus pisorum* Linn.

The adult beetle is about one-fifth of an inch long, and the wing covers are marked with small black and white spots. It

* F. H. Chittenden, Farmers' Bulletin No. 45, U. S. Department of Agriculture, page 19, 1896.

lays eggs singly on the outside of the green pods in the field, and the larva tunnels through the pods and into one of the green peas. The insect does not mature until the peas have ripened and have been harvested and placed in storage. Then it is common to find a single round hole in a pea where the adult has emerged. Sometimes nearly every pea has a hole in it, and many larvae are unquestionably cooked and eaten in green peas; but the insect does not go on breeding in dry stored peas, there being only one brood each year.

The pea weevil is more serious in the Middle Atlantic than in the Northern States, but it is present in Connecticut. In the Southern States it is claimed that late planting brings comparative immunity from attack but in the writer's experience late planted peas seldom produce a satisfactory crop here. Hence it is better to treat the seed soon after harvesting, and to make allowance in planting for a certain percentage of injured seed. This insect is shown on plate XXIV, e.

The Common Bean Weevil, *Bruchus obtectus* Say.

This is probably the greatest enemy of beans in Connecticut, and though in size somewhat smaller than the pea weevil and resembling it in color and markings, it differs from it by continuing to breed in the dry, stored seed. There are six generations annually in the District of Columbia, and a smaller number in the northern states. Stored beans are often entirely destroyed, or at least rendered unfit for planting, or as food for man or beast. The beans often have several holes in each where the adults have emerged, and as many as 28 have been found in a single seed. Severely weeviled beans are almost useless for planting, but the good seed may be separated from the infested seed by throwing into water. The injured seed will float and may be discarded. This beetle and its work are shown on plate XXV.

The Four-Spotted Bean Weevil, *Bruchus quadrimaculatus* Fabr.

This species is somewhat more slender than the preceding and has different markings. Its habits and life history are similar and the same control methods may be practiced.

THE DRUG STORE BEETLE, *Sitodrepa panicea* Linn.

Of all the insects attacking stored food products, perhaps none is more cosmopolitan or feeds upon a greater number of different kinds than the drug store beetle. It is a common pest of all kinds of stored vegetable foods and may be found in breakfast foods, or the dried roots, stems, bark, and seed capsules commonly called spices. It feeds also on the parts of plants used as drugs, often eating those which are bitter and poisonous to man. It has been recorded as attacking forty-five different drugs. It is now distributed throughout the civilized world, and four or five generations may occur in a year, especially in a heated building.

The beetle is about one-tenth of an inch in length, covered with a silky pubescence, and reddish-brown in color. The wing-covers are longitudinally striated and the antennae terminate in three long segments forming the so-called "club." The larvae are white, with dark mouth parts, and assume a curved attitude when at work in their burrows. The adult is shown on plate XXIV, a.

THE CONFUSED FLOUR BEETLE, *Tribolium confusum* Duv. and THE RUST-RED FLOUR BEETLE, *Tribolium ferrugineum* Fabr.

The confused flour beetle has been known to occur in this country for nearly twenty-five years and has caused injury throughout the land. It attacks seeds, stored cereals and other starchy foods and drugs, and is a pest in flour and grain mills.

The adult is a flattened brown beetle, less than a sixth of an inch in length. There may be as many as four generations annually in a heated storehouse.

The rust-red flour beetle closely resembles the preceding, but is not nearly as common in Connecticut. It is a pest in the Southern States and is often shipped north in rice or other starchy food products.

THE SAW-TOOTHED GRAIN BEETLE, *Silvanus surinamensis* Linn.

One of the most common beetles in grain and stored food products is the saw-toothed grain beetle. It is less than an eighth of an inch long, flattened, grooved longitudinally, with teeth-

like projections on the sides of the thorax, and brown in color. The larva is white, extremely active, and makes its pupa case on some convenient surface by joining together particles of the infested material with some adhesive substance which it secretes.

There are probably four or five generations each year, and the beetles eat through paper bags and pasteboard boxes to reach foodstuffs inside. Though perhaps preferring farinaceous foods, this beetle often infests fruits and almost all kinds of stored food products. This beetle and its injury to corn are shown on plate XXVII, a and c.

A flat, smooth, reddish-brown beetle, still smaller than the preceding, is occasionally found infesting wheat bran or other cereals. This is *Læmophlœus pusillus* Schr., one of the minor pests but nevertheless capable of causing much injury.

The Granary Weevil, *Calandra granaria* Linn.

Both this weevil and the following belong to the family Calandridae or snout beetles. The adult is a shiny reddish-brown snout beetle nearly an eighth of an inch in length, with a long proboscis. The larva is a legless grub. Both adult and larva feed upon the kernels of the grain. There are four or five generations each year in the vicinity of Washington, D. C., and more farther south. It attacks and injures maize and all of the small grains.

The Rice Weevil, *Calandra oryzae* Linn.

This species resembles the preceding except that it is dull brown instead of shining, and the thorax is more densely pitted. There are four more or less distinct red spots on the wing-covers. This insect is often found in the field and takes its name from the rice which it infests. Its habits and life history are otherwise similar to the preceding. It is shown on plate XXIV, c.

THE FLOUR AND MEAL MOTHS.

The Indian Meal Moth, *Plodia interpunctella* Hubn.

Considerable damage is done each year in mills, granaries, seed warehouses, etc., by the Indian meal moth, which is also a common pest of the household, as it attacks nearly all kinds of

vegetable food products. Each year some food material infested by this insect is brought to the writer's attention. In 1905 some large seed warehouses near New Haven were found infested, and one room was fumigated with hydrocyanic acid gas. This treatment killed the larvae crawling about, and those at work near the outside of the bags, and at first seemed to be effective. Later, however, living larvae appeared from inside, showing that the gas did not penetrate far into the mass of grain.

The larvae web together the grain and flour, especially around the outside. One 100-pound bag of corn was emptied and seven pounds adhered to the bag. The kernels were eaten at the embryo, and are shown on plate XXVII, d.

The eggs are small, white, and laid singly or in groups, and each female may lay as many as 350. The larva is whitish, and spins a silk thread wherever it feeds and travels, and the web

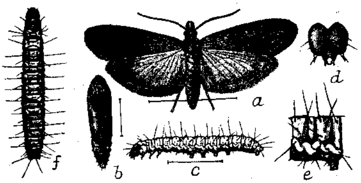

Figure 4. Indian meal moth. *a*, adult; *b*, pupa; *c*, larva, side view; *d*, head of larva, front view; *e*, first abdominal segment of larva; *f*, larva, dorsal view—all greatly enlarged. (After Chittenden, Bur. of Ent., U. S. Dept. of Agriculture.)

holds together the particles of food material. Pupation takes place in a silken cocoon-like web from which the moths emerge. From four to five weeks only are required for a generation to develop. In a heated building this insect will breed throughout the year.

The adult is a small moth having a wing-spread of about five-eighths of an inch; forewings whitish at base with distal half reddish-brown, as shown in figure 4.

The Mediterranean Flour Moth, *Ephestia kuehniella* Zell.

This insect is regarded by Chittenden as the most important of all the species infesting flour and grain mills. It has been reared from flour in New Haven and has been taken at Branford. In life history and injury the Mediterranean flour moth resembles the Indian meal moth, and in heated buildings five or six broods may occur each year. The moth is shown on plate XXVI, c. It is larger than the Indian meal moth and has a wing-spread of about an inch. The forewings are dull lead-gray, crossed by zigzag darker lines or bands. Not only does this insect injure flour and grain but also feeds upon almost any kind of stored vegetable food products.

The Meal Snout Moth, *Pyralis farinalis* Linn.

This insect infests flour, meal, and other stored food products, though not as serious a pest as the Indian meal moth or the Mediterranean flour moth.

The larvae have the habit of constructing long tubes by binding together with silk small particles of the meal or food material. In these tubes the larvae live and hide until fully grown when they leave the tubes and spin their cocoons, usually in or just outside of the infested material. There are probably three or four generations each year, though further studies are needed in this latitude to determine this point.

The adult has a wing-spread of about an inch, is light brown, with thorax, base and apex of fore wings darker brown, and with whitish wavy lines crossing front and rear wings, as shown on plate XXVI, a.

THE GRAIN MOTHS.

The Angoumois Grain Moth, *Sitotroga cerealella* Oliv.

This destructive insect was known in France nearly two hundred years ago, and was somehow brought to this country in the early colonial days, and became established in North Carolina and Virginia. Since then it has spread northward to Massachusetts, New York and Michigan and throughout the southern states, where it does much damage. The writer first noticed it in Connecticut nearly twenty years ago, and has run across it a

number of times since. It is primarily a pest of stored grains, especially corn on the ear, which if infested soon appears as shown on plate XXVII, b. The emerging moths leave small circular holes in the kernels. Infested grain is injured not only for seed, but also for feeding purposes; as it has been estimated that it loses within six months 40 per cent. of its weight and 75 per cent. of the starchy matter. The moth lays whitish eggs on the kernels of corn, and they soon turn to a pale reddish color and hatch in five or six days. Two or more larvae may occupy a single kernel of maize, though only one occurs in a grain of wheat. The adult is a light, grayish-brown moth, having a wing-expanse of about half an inch, somewhat resembling a clothes moth. Out of doors in the southern states there are at least four broods annually and the larva passes the winter in kernels of grain. In this climate it breeds only in stored grain, and in heated buildings this goes on continuously, there probably being five or six generations, depending upon the temperature.

The European Grain Moth, *Tinea granella* Linn.

Compared with the Angoumois grain moth this moth is of secondary importance, and seems to be not especially destructive in the United States. It infests all kinds of cereals, and as each larva may pass from one kernel into another, webbing them together until twenty or thirty grains are spoiled, it is apparent that considerable injury must result.

This moth was first found in Connecticut, in 1906,* in a seed warehouse in Milford. It is now distributed throughout the northern states.

The adult is a slender moth with a wing-spread of half an inch, creamy white mottled with brown. This moth and its work are shown on plate XXVI, b and e.

OTHER INSECTS OCCASIONALLY ATTACKING FOODS.

The large cabinet beetle, *Trogoderma tarsale* Melsh., frequently injures seeds and is shown on plate XXVI, d. The small cabinet etle, *Anthrenus verbasci* Linn., and the black carpet beetle,

* Report of this Station for 1906, page 305.

Attagenus piceus Oliv., occasionally attack and injure food products, though the latter is a more important pest of clothing.

The larder or bacon beetle, *Dermestes lardarius* Linn., the red-legged ham beetle, *Necrobia rufipes* Fabr., and certain species of mites of the genus *Tyroglyphus* sometimes injure dried meats, cheese, dried fruits, cereals, etc. The cigarette beetle, *Lasioderma serricorne* Fabr., though primarily a pest of tobacco, feeds upon the spices, rice, figs and many other food products. Then the cheese skipper, *Piophila casei* Linn., which occurs everywhere, often attacks cheese and the larvae may be found tunneling in it. Cheese should be kept covered and should be examined every day in warm weather. Hams and other kinds of meat are infested only in certain portions which can be cut off and the remainder used for food.

A species of book-lice, *Troctes divinatorius* Müll. (order Corrodentia), was found eating corn at the Station in 1900. The sample was stored in a ground glass-stoppered jar. The outer surface of the kernels was wholly eaten off, so as to render the variety wholly unrecognizable.

Cockroaches and ants are also frequently injurious in pantries and storehouses. The former are usually susceptible to the influence of powdered borax, and ants can usually be driven away by scattering naphthalene flakes about on the floor and shelves, especially where the ants have their runways.

The other insects mentioned in this chapter without control methods may be killed by heat or by fumigation.

CONTROL METHODS.

The chief methods for preventing damage by the insects mentioned in the foregoing pages are: the use of high and low temperature, air-slaked lime, pest-proof packages and fumigation.

Temperature.

Temperature is recognized as an important factor in insect development, and often determines in a measure the number of annual generations of certain species. Extremes in temperature are sometimes employed for the control of insects.

HEAT.

It has long been known that heat will kill insects, and one of the simplest methods of destroying them in small packages of flour or other food products is to heat it in the oven for an hour or so. Following this idea Professor George A. Dean started some experiments in Kansas in 1910 to determine the fatal high temperatures for certain grain-infesting insects, and found that few insects can withstand a temperature of from 118°-125° F. for any length of time. In a mill there are accumulations of meal and floor on the floor, beams, machinery, and in the corners everywhere in which insects can breed. To keep a mill free from this accumulation and absolutely clean is almost an impossibility. By the use of heat, however, the insects can be killed from time to time without serious inconvenience, without shutting down the mill, and without great expense. It requires extra steam pipes sufficient to raise the temperature to about 120° F., and to keep it there for a period of five or six hours to allow the heat to penetrate the bins and bags of grain. Professor Dean has published three papers on this subject,* and any one interested should write to him for further advice.

Any grain or seeds which are intended for planting should not be heated to a point much greater than 130° F. as there is danger of injuring the vitality, which with some seeds ceases if the temperature approaches 150° F.

Any product to be used for food will not be injured by this heating method and even the eggs and larvae, as well as the adult insects, are killed by it.

COLD.

A low temperature is not so frequently used for destroying insects, yet it has been known for a long time that insect development is arrested or suspended altogether in cold storage.

Mr. J. A. Manter† of Storrs, Conn., states that the bean weevil will not breed in cold storage and suggests that beans be stored

* Journal of Economic Entomology, Vol. IV, page 142, 1911; Vol. VI, page 40, 1913. Kansas Agricultural Experiment Station, Bull. 189, July, 1913.

† Journal of Economic Entomology, Vol. X, page 193, 1917.

in unheated buildings. This idea may be carried out in practice with certain other stored food insects but the exact temperatures have not yet been determined for all species.

AIR SLAKED LIME.

A very simple and promising treatment to prevent weevil injury to peas, beans, cow peas and possibly to other kinds of seeds has recently been discovered by Mr. Z. P. Metcalf* of the North Carolina Station. This consists of applying air-slaked lime to the seeds, using one part by weight of lime to two parts of seeds when placing the crop in storage. For small quantities, say less than a half peck, Professor Metcalf advises the writer in a letter that four parts of lime should be used to one part of seeds; for quantities between a half peck and three bushels, use equal amounts of lime and seeds. The quantity of seeds to be stored thus influences the effectiveness of the treatment and necessitates greater proportions of lime for small quantities. In time this method may be found applicable to other kinds of seeds and against other insects. It has the advantage of being harmless to seeds and to the operator, as well as being convenient to procure and relatively inexpensive. Professor Metcalf is now completing further tests of this material. Plate XXV, c, shows untreated seeds and those treated with lime.

PEST-PROOF PACKAGES.

Materials sealed in glass or metal containers are usually safe against insects as long as they remain unopened. We have a number of records showing that the smaller beetles, like the saw-toothed grain beetle, will enter poorly stoppered glass bottles and jars and even tin-stoppered cans. The material is of course often infested before placing in the containers.

Mr. William B. Parker of the U. S. Bureau of Entomology has made investigations and suggests† a sealed paper carton for packing cereals which are to be placed upon the market. While this may prevent infestation in stores and warehouses, in the

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* Journal of Economic Entomology, Vol. X, page 74, 1917.

† Bulletin 15, U. S. Department of Agriculture, 1913.

household many opened packages often attract insects, and if stored for a long time no paper package is insect-proof. Hence other methods must be resorted to, especially in dwelling houses, to keep the foodstuffs free from insect attack.

Fumigation.

Fumigation has long been practiced to kill insects in seeds and food substances. For this purpose two materials are commonly used, viz., carbon disulphide and hydrocyanic acid gas.

Carbon Disulphide (Bisulphide).

This is a colorless, ill-odored liquid which volatilizes at air temperatures, more readily in warm weather, and the fumes are deadly to all forms of insect life. Carbon disulphide may be purchased in pound bottles from any wholesale druggist, and as it is inflammable when the fumes are mixed with air, it should not be used by any one smoking, or at night with oil or gas lights near. As the fumes are heavier than air the liquid should be placed on top, rather than at the bottom of the grain, seeds or material to be treated. It should also be placed in a shallow dish to facilitate volatilization. The quantities used are about one pound to each 40 bushels of seeds, or to each 100 cubic feet of space. In a tight barrel containing grain or seeds, about one-half cupful of the liquid should be placed in a saucer on top of the seeds, the barrel covered tightly and allowed to remain all day or longer. For smaller receptacles, use proportionate quantities of the liquid. Carbon disulphide is more convenient, less dangerous to the operator, and its fumes penetrate better than hydrocyanic acid gas. A recent bulletin by Dr. Hinds* contains much information about carbon disulphide and may be obtained by applying to the U. S. Department of Agriculture, Washington, D. C.

Hydrocyanic Acid Gas.

This is a deadly poisonous gas generated by putting together cyanide, sulphuric acid and water. Potassium cyanide was

* Farmers Bulletin 799, U. S. Department of Agriculture, June, 1917.

formerly recommended, but sodium cyanide is now the cyanide of commerce and is effective. The quantities for 100 cubic feet of space are as follows:

Sodium cyanide	1 oz.
Commercial sulphuric acid	2 fluid ozs.
Water	4 fluid ozs.

If a room is to be fumigated its cubic space must be ascertained and the chemicals carefully weighed or measured. It must be made reasonably tight, and provision must be made for opening from the outside at least one window or door, besides the exit. The generating jar may be earthen or stoneware but never metal. The acid may be diluted with the water, the cyanide placed in a paper or cheescloth bag, and when all is ready the operator should drop the bag into the jar and with bated breath retire at once and close and lock the door. One full inhalation of this gas will drop a man, and no carelessness should be permitted. The house or room should be exposed for at least two hours and may remain closed over night or over Sunday. The fumes do not penetrate as well as those of carbon disulphide.

Recently Mr. E. R. Sasscer of the U. S. Department of Agriculture has devised an apparatus for fumigating cotton bales, bags of seeds, etc. By removing the air and forcing the gas into a partial vacuum thus created, most insects are killed with a half hour exposure.* On account of the danger, trouble of generating, etc., the average farmer and householder will seldom use hydrocyanic acid gas and will find carbon disulphide or heat sufficient to meet his needs.

SUMMARY.

Much damage results each year in Connecticut to cereals and other stored food products from the attacks of insects. This injury has been estimated at five per cent of the total value of the products, or $200,000,000.00 each year for the United States, and is wholly preventable.

The insects are chiefly beetles (*Coleoptera*) and moths (*Lepidoptera*). The former include the meal worms, cadelle, pea and bean weevils, drug store beetle, confused flour beetle, rust-red flour

* Bulletin 186, U. S. Department of Agriculture, 1915.

beetle, saw-toothed grain beetle, granary weevil, rice weevil, large and small cabinet beetles, black carpet beetle, larder beetle, red-legged ham beetle, and cigarette beetle. The latter include the Indian meal moth, Mediterranean flour moth, meal snout moth, Angoumois grain moth, and European grain moth. Other insects like the cheese skipper (a fly), a book louse, ants, cockroaches, and even mites occasionally cause damage.

The most important of these pests are described briefly in the preceding pages.

Most of these insects may be destroyed by raising the temperature to a point between 120° and 130° F. for five or six hours. The vitality of seeds is endangered if the heat approaches 150° F. *but the material would not be injured for food.*

Food kept in cold storage will not be injured by insects.

Various pest-proof packages have been devised, but food often becomes infested in them, and no package is pest-proof after the seal has been broken.

Air-slaked lime applied to seeds when placed in storage will prevent most of the damage caused by the pea and bean weevils. The proportions are as follows: For small quantities, say less than a half peck, four parts of lime to one part of seeds; between a half peck and three bushels, equal parts of lime and seeds; for greater quantities, one part of lime to two parts of seed.

Fumigating with carbon disulphide, using a half cupful to a barrel, will rid the material of insect life. This liquid should be placed on top of the infested material, and should not be used near a fire as it is inflammable. The container should be tightly covered for twenty-four hours or longer.

Hydrocyanic acid gas may also be used but is not advised except in particular cases, as it is deadly to breathe and does not penetrate masses of flour and grain readily. Seeds and food materials if thoroughly aired are not injured by carbon disulphide or hydrocyanic acid gas, either for food or for planting.

For more detailed information on this subject the reader should refer to pages 330 to 343 of this Report.

MOSQUITO WORK IN CONNECTICUT DURING 1917.

By B. H. WALDEN.

Legislation. The State law providing for the elimination of mosquito breeding places, Chapter 264, Public Acts of 1915 (See 15th Report Conn. State Entomologist, page 141, 1915), was amended by the 1917 Legislature to read as follows:

Chapter 402.

AN ACT AMENDING AN ACT PROVIDING FOR THE ELIMINATION OF MOSQUITO BREEDING PLACES AND AREAS.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. The director of the Connecticut Agricultural experiment station may make rules and orders concerning the elimination of mosquitoes and mosquito breeding places, and he or his agent may enter upon any swamp, marsh or land to ascertain if mosquitoes breed thereon, or to survey, drain, fill or otherwise treat or make any excavation or structure necessary to eliminate mosquito breeding on such land.

SEC. 2. Whenever funds have been provided by the town, city or borough, in which any such swamp, marsh or land is located, or by voluntary contribution, sufficient to pay three-fourths of the cost, as estimated by said director, of work of eliminating mosquitoes or mosquito breeding on such swamp, marsh or land, and moneys appropriated by the state are available sufficient to pay one-fourth of said cost, or whenever funds have been provided from other sources than the state sufficient to pay all of said cost, said director may order the execution of said work upon notice as herein provided. At least thirty days before commencing such work, said director shall file a copy of such order, with a description of the place or area affected and a statement of the proposed plan thereof, in the town clerk's office in each town in which such place or area is located. Said director shall publish a copy of such order once each week for two successive weeks in some newspaper having a circulation in the town or towns in which such place or area is situated, and shall mail a copy of such notice, postage prepaid, by registered mail, addressed to each record owner of land whose name and address may be ascertained by a reasonable inquiry from the assessors of the town in which such land is situated. Said director may, and upon application of any person affected by such order or plan, within thirty days after such publication, shall assess benefits received and damages sustained by the owner of any such land. Such assessment shall be filed by said

director with the clerk of the superior court of the county within which the land affected is located, and said clerk shall give notice of such assessment to each such property owner, by mailing to him a copy of such assessment, postage prepaid. Any person claiming to be aggrieved because of such order or proposed plan or such assessment may, within ten days after notice, apply to the superior court in the county in which such land is situated, or any judge thereof, for relief, and said court or such judge may, after notice to said director and parties applying for relief, and hearing thereon, make any proper order concerning such order or proposed plan, or make a reassessment of benefits and damages. Said court or judge may view the land claimed to be affected by such order or plan and may take any evidence in its opinion material. The order, plan and assessment as hereinbefore provided for shall be conclusive upon all parties affected thereby, and the state treasurer shall pay to any such owner the damages assessed by said director or by said court or judge, as the case may be, upon certification of the amount by the clerk of said court. Benefits assessed as herein provided shall be collected by said treasurer and shall constitute a lien upon the land against which the same were assessed until the amount thereof has been paid with interest at the rate of six per centum per annum, which lien may be continued by filing in the office of the town clerk of the town where such land is situated a certificate thereof within sixty days after the assessment of the same, and such lien may be foreclosed or the benefits secured thereby collected in any other proper form of action. The town wherein such land is located shall reimburse the state for three-fourths of the damages assessed and paid as herein provided, and the state treasurer shall pay to any such town one-fourth of all benefits received. All amounts collected from towns under the provisions of this section may be expended for the purposes stated in said section. The pendency of any application for the assessment of benefits and damages shall not prevent or delay the execution of the work for the elimination of mosquitoes or mosquito breeding. Upon the completion, to the satisfaction of said director, of any such work one-fourth of the cost of which is payable by the state as hereinbefore provided, said director shall certify to the comptroller, with proper vouchers, the amount of such costs, and the comptroller shall draw his order on the treasurer for such sum as, with any amounts advanced on account thereof as hereinafter provided, shall amount to one-fourth of the cost of such work.

Sec. 3. Whenever any swamp, marsh or other land has been drained to the approval of said director, he shall keep the same in repair and free from obstruction, and construct or repair tide gates or otherwise treat such areas so as to make such work effective. The cost of such maintenance or treatment, not exceeding in any year one dollar per acre, shall be paid by the state, and the city, borough or town within which such place or area is located shall reimburse the state for three-fourths of the amount so expended for maintenance and treatment of such place or area. The provisions of this section shall apply to work executed prior to the passage of this act, provided such work shall be approved

by the director. Said director shall certify to the comptroller the amount due from any city, borough or town under the provisions of this section, and the treasurer of such city, borough or town, as the case may be, shall pay to said comptroller the amount so due upon receipt of a bill therefor. All amounts so collected shall be available for expenditures under the provisions of this section.

Sec. 4. Said director may appoint one or more deputies to supervise the work done under the provisions of this act, who may exercise the authority granted to such director, and the expenses of said director and said deputies for supervision and inspection shall be included in computing the cost of any such work.

Sec. 5. The sum of five thousand dollars is appropriated for the purpose of carrying out the provisions of sections one and two of this act, and five thousand dollars for carrying out the provisions of section three of this act. The comptroller may advance to said director such amounts, within such appropriations as are necessary to meet the current expenses for the labor authorized under the provisions of this act.

Sec. 6. This act shall take effect from its passage.

Approved May 16, 1917.

As section 4 of Chapter 264, Public Acts of 1915, was not repealed it still remains in force and is as follows:

Any person obstructing the work of examining, surveying, or ditching, or otherwise treating such mosquito breeding areas, or obstructing any ditch, canal, or drain, or the natural outlet of any marsh forming mosquito breeding areas, shall be fined not more than one hundred dollars, or imprisoned not more than ninety days, or both.

The new law provides for a more adequate method of notifying property owners regarding the ditching of their marshes, and provides for assessing benefits and damages in case the owners wish to apply to the courts. At the same time the law specifies that the work shall not be delayed while adjustments are being made. The measure carries an appropriation of $5,000.00 to pay for one-fourth of the cost of new work done under this law.

The maintenance of the work is placed under the Director of the Experiment Station instead of under the towns, as provided in the 1915 law, an appropriation of $5,000.00 being made to pay for one-fourth of the maintenance, which is not to exceed one dollar per acre during one year. Work done before the passage of the Act may be maintained as above after such work has been approved by the Director.

On June 1 the writer was appointed by the Director, Deputy in charge of mosquito elimination work.

New Haven Work.

The City of New Haven appropriated $10,000 for mosquito elimination work during 1917, which was to be expended under Chapter 264 of the Public Acts. The Anti-Mosquito Committee, Inc., of the New Haven Civic Federation, which had raised the funds and had charge of practically all the mosquito work done around New Haven, recommended that this money be used to ditch the remaining undrained salt marsh areas in the town of New Haven. These marshes were as follows: The Fort Hale or Harbor Marsh north of Fort Hale Road, about 120 acres; all of the Quinnipiac Marsh in the town limits, containing about 300 acres; and the West River Marsh between Congress Avenue and Chapel Street, 130 acres, making a total of 550 acres. This recommendation met the approval of Dr. Jenkins and plans were made to go ahead with the work.

The notice or order regarding the proposed mosquito work was published in the *Journal-Courier* on May 25, and under the law it was necessary to wait thirty days before starting the ditching. Two of the leading mosquito drainage firms were asked to bid on the work, and the contract was awarded to the United States Drainage & Irrigation Company of New York, the firm that did the ditching work around New Haven in 1912. The contract was let on a footage basis at a price of 2 5-8 cents per linear foot for 10" x 24" ditches. The Harbor Marsh and the Quinnipiac Marsh, like many other marshes in the State, contained many old ditches which we considered advisable to use in the new system in order not to cut up the marshes unnecessarily. Furthermore, many of these ditches form boundary lines between property owners, and in our previous work serious objections have been made where these boundary ditches have been disregarded, or where new ditches have been cut a few feet from the old ones. As the majority of these old ditches have to be cleaned by day laborers, it was specified in both bids that the cost of cleaning old ditches be figured as the equivalent of a double 10" x 24" ditch.

Harbor Marsh. The Harbor Marsh was the first one to be ditched. Work was started on June 27 and completed on July 5. The equivalent of 44,443 feet of ditch was cut. For a number of years there has been considerable mosquito breeding on the lower end of this marsh near Fort Hale Road, where the only outlet was a ditch to the south, emptying into the moat surround-

ing the old fort, where the water was so high that there has been very little drainage through this ditch. Formerly this portion of the marsh was drained by a ditch, long filled up, with an outlet into the harbor about 1,400 feet to the north. This ditch was re-opened, and while it lowered the water so that there was very little breeding during the remainder of the season, it does not carry off the water as well as expected.

Quinnipiac Marsh. The Quinnipiac Marsh was ditched between July 5 and July 28, a total of 167,988 feet of ditches being dug. The New York, New Haven & Hartford Railroad is filling a section of this marsh south of the Air Line tracks next to the Quinnipiac River. When the filling is completed it will cut off the drainage into the Quinnipiac River of a considerable section of the marsh to the east, and the new ditching has been planned to carry the water eastward into the large creek. It will be necessary to watch this system for another season in order to determine if it is adequate to prevent mosquito breeding. Plate XXVIII shows the appearance of a section of this marsh both before and after ditching.

West River Marsh. The ditching on the West River Marsh was started on July 20, and completed on August 27. 38,355 feet of ditches were cut. The conditions on this marsh are controlled by the large tide gates at the Congress Avenue bridge. These gates have leaked badly for several years and considerable of the time the water in the river has been high, flooding sections of the marsh. During the summer the city repaired these gates, but it is the writer's opinion that a great deal of water leaks through under the sill and that this defect was not remedied. Whether these gates can be kept in satisfactory repair, or whether it would be cheaper in the long run to build new gates is a problem that should be decided by an engineer who is familiar with the construction and operations of tide gates. It is also my opinion that the river needs dredging near the Derby Avenue bridge, and possibly at other points, before the water can be lowered sufficiently above Derby Avenue. Under the present conditions we cannot expect to obtain the best results from the ditching. Much of the surface water of the marsh, however, will be concentrated in the ditches, and the larger pools and lagoons have been connected by ditches with the river, which will prevent the water from becoming stagnant.

Aside from the problems mentioned in connection with the different marshes, the work has been satisfactory and many serious breeding areas have been eliminated. Had it been possible to complete the work in the spring, this season's results would have been much more apparent. During the early part of July when the ditching work was only well started, conditions were extremely favorable for mosquito breeding. The perigee tide was followed by east winds and frequent rains, which kept the depressions in the marshes filled with water, producing one of the largest broods of salt marsh mosquitoes known at this season of the year. Fresh water breeding was equally plentiful.

East Haven Work.

The Cosey Beach Improvement Association raised sufficient money to drain the small but serious mosquito-breeding marsh back of the Silver Sands summer colony and just west of the Momauguin shore resort. The outlet ditch of this marsh crossed the highway to the south and extended to the west for several hundred feet through a number of back yards where the property owners had covered the ditch or partially filled it, as they saw fit. It then again crossed the road to the north and extended to the west into Caroline Creek. The town authorities gave permission to cut an outlet north of the highway and on the town's right of way. This new outlet was 30 x 20 inches and about 700 feet long, and extended through a point of hard land where a number of rocks had to be blasted. While the cost was greater than that of ditching the marsh, it probably cost no more than it would to build two new culverts and clean the old ditch, and the new ditch is much more direct and will be considerably cheaper to maintain.

Additional ditches were cut in the marsh partially ditched in 1912, on the east side of Caroline Creek and connecting with this new work. The above work has done away with practically all of the salt marsh mosquito breeding from Caroline Creek to Mansfield Grove. As all of the money raised by this Association was not expended, the remainder will probably be used in the spring on the marshes back of Mansfield Grove.

Orange Work.

The contract which was let in December 1916, for ditching the lower part of Old Field Creek Marsh in West Haven, was carried

out this spring, the work being completed before the end of May. The town authorities co-operated with the members of the West Haven Anti-Mosquito Committee, who raised the money for the above work, built a new tide gate at the outlet of Old Field Creek, and cleaned the channel of the creek north of Blohm Street through the town property where the sewage disposal plant is located. Dr. Charles D. Phelps, a member of the Committee, has given all this work his personal attention. Plate XXIX shows a portion of this marsh before and after ditching.

Hamden.

The town, as in 1916, appropriated $300.00 to be used in anti-mosquito work during 1917 by the Health Officer, Dr. George H. Joslin. Efforts will be made to have this appropriation increased for 1918 in order to drain a serious malarial breeding swamp between Schuetzen Park and the railroad, just north of the New Haven town line.

Branford, Guilford and Madison Work.

The mosquito drainage work in Branford, Guilford and Madison during 1916 was done under Chapter 264 of the Public Acts, which provided that the maintenance be done by the towns. Early in April the selectmen of these towns were notified of this fact and advised of the importance of starting this work at once. In Madison the ditches were all cleaned under the direction of the first selectman before the middle of May. The work was gone over in Guilford and the principal obstructions in the ditches removed, while in Branford no work was done by the town.

After the present law was passed placing the maintenance under the Director of the Agricultural Station, the work was started as soon as possible. Plans were made to divide the territory into about three districts and engage a man to take charge and be responsible for the results in each district, hiring laborers for doing such work as was not practicable for him to do.

Mr. Joseph S. Miller, a student of the Connecticut Agricultural College, who was specializing in entomology, was engaged to take charge of one district. The season was so far advanced that most of the men who are usually available for summer work had already secured employment or entered training camps, and we

were unable at short notice to obtain suitable men for the remaining districts. As no work had been done in Branford, Mr. Miller started cleaning the ditches in this town and later took charge of the maintenance work in the other two towns.

BRANFORD.

After considerable difficulty, owing to the labor situation, two laborers were engaged and work was started June 4 on the Hotchkiss Grove Marsh. During the winter the tide gates at the outlet became damaged so that the marsh was flooded with water and many of the ditches partially filled with mud. Nearly full-grown larvae of *Aedes cantator* and *A. sollicitans* were present in many pools and even in some of the obstructed ditches, especially in the upper section of the marsh. These breeding places readily drained away when the ditches were cleaned, but as there was not sufficient time to go over the whole area before the adults emerged, a number of the breeding places were oiled.

The ditches in the remainder of the marshes in the town required only a small amount of cleaning aside from the removal of sod placed in the ditches by the farmer to bridge them, and occasional stoppage casued by material which had been carried in by high tides.

GUILFORD.

After the work was well started in Branford, the marshes in Guilford were inspected and it was found that while the principal obstructions had been removed by the town, very little had been done to remove the mud which had accumulated in many of the old ditches. Work was commenced as soon as laborers could be hired, and those employed in Branford were later moved to Guilford.

The small tide gate at the Leete Marsh was found to be leaking badly around the box where the water had worked through. A member of the Connecticut Shore Mosquito Extermination Association, who had a summer residence in the vicinity, offered to pay the cost of having a concrete facing, on which to hang the gate, built on the outer side of the box. This improvement was made and the water in the ditches was lowered sufficiently to thoroughly drain the marsh.

The need of a new tide gate at the outlet of the Great Harbor Marsh has been apparent during the past two seasons. Authority for building tide gates is granted in the new law under Maintenance (Sec. 3) so that the cost of construction, together with the cost of maintenance, is limited to one dollar per acre. Plans were made for a new gate to be attached to the trestle of the Shore Line Trolley which crosses the Great Harbor Creek near its outlet. By the time estimates on the cost of building could be obtained and permission received from the trolley officials to attach the gate to their structure, it seemed advisable to wait until spring before installing the gate.

Before all the Guilford marshes could be covered, the July perigee tide occurred, which was abnormally high, due to strong east winds. This was followed by frequent rains and produced scattered breeding over the marshes. Many complaints were received regarding the abundance of mosquitoes in Guilford borough which did not seem to be explained by the amount of marsh breeding. Mr. Miller investigated the matter and reported that nearly every rain barrel and receptacle containing water that he examined were breeding mosquitoes. Many unused boats with water in them also contained wrigglers. One individual, living on one of the main streets, who was complaining to Mr. Miller about the abundance of mosquitoes, was shown prolific breeding in a boat in his back yard.

MADISON.

The box culverts that were placed in the outlets to several of the small marshes in 1916, all remained in place during the winter. While the ditches on the Madison marshes were cleaned in the spring by the town, there are a number of small marshes that are drained through old outlet ditches which require considerable cleaning throughout the season, thus adding materially to the cost of maintenance.

Cost of the Maintenance Work.

Labor	$1,193.57
Tools and supplies	29.24
Supervision and Inspection	424.29
	$1,647.10
Cost per acre	.617

The results of the maintenance work in these shore towns was as satisfactory as could be expected under the circumstances. The greater part of the work which should have been done early in the spring, had to be done after the first of June when the breeding season was well under way.

It was not practicable to organize the work and engage men beforehand in anticipation of the passage of the law. Labor was scarce and the majority of the few men looking for work preferred other kinds to that on the salt marsh, even though the pay was less. It was necessary to pay nearly twice as much for laborers as it would have been two years ago.

Fairfield Work.

The salt marshes in the town of Fairfield, about 1,250 acres, were ditched to eliminate mosquito breeding in 1912, the necessary funds being raised by private subscription. The work has since been maintained under the supervision of the Improvement Association of Fairfield. During the last week in June a request was received from the first selectman of the town that the maintenance of this work be taken over by the Director of this Station, under the new law. The work was inspected by the writer and approved on July 11. The maintenance work was being done by Mr. Nicolas Matinck, who had also been employed during 1916. Mr. Matinck continued with the work until September 1.

Proposed Work in Westport.

Early in the spring the State Comptroller requested that the marshes in the town of Westport on or adjoining the State Aviation Park at Alvord's Beach, be examined to determined the mosquito breeding conditions. Westport is the only town between Fairfield and the New York State line where the salt marshes have not been drained to eliminate mosquito breeding. As it will be necessary to ditch all of these marshes in order to obtain any definite results, all of the salt marshes in the town were examined on April 16. The report sent to the Comptroller was as follows:

WESTPORT SALT MARSHES.

Examined April 16, 1917, by B. H. Walden.

There are about 330 acres of salt marsh in the town of Westport. The problem of ditching to eliminate mosquito breeding is a simple one. The areas are comparatively small and well supplied with natural water courses or creeks. These marshes, like most of those in the state, were formerly ditched for salt hay farming, and while salt hay is still cut on considerable of the area, the ditches have been neglected and most of them nearly filled up. While the whole area needs ditching, with a few exceptions, it probably will not be necessary to cut ditches nearer than 150-175 feet apart.

Detailed accounts of the separate areas follow: 1 & 2. Marsh southwest corner of town west of the Saugatuck River. Area about 74 acres. Adjoining marsh in Norwalk ditched in 1912. This area requires the longest ditches of any marsh in the town (about 1,000 feet). It may therefore be necessary to place them not over 125-150 feet apart.

Salt hay was cut on a large portion of this marsh in 1916 and the western part of it was fairly hard and dry on April 16.

3. About 5½ acres. Appears to be well drained. Hay cut in 1916. May require a few short ditches.

4. Marsh west of station south of railroad tracks. Thirteen acres. Good natural drainage. Probably needs marginal ditches. West of the highway is a small marsh of less than one acre, the outlet leading through a culvert under the road into a creek of No. 4. This marsh is in a very bad condition and needs thorough ditching. Probably considerable fresh water comes onto this marsh and the indications are that it is a malarial mosquito breeder.

5. This is the upper end of the marsh No. 4 above the railroad tracks. The main ditch needs cleaning the whole length. Sink drains on the western bank run into this marsh producing an unsanitary condition; tile drains should be laid to the main ditch.

6. Small narrow marsh west of main road east of Cedar Point. About ½ acre of the lower end of this marsh needs ditching.

7. West side of Mill Cove. Area 20 acres. Upper portion needs ditching. Hay cut on most of this marsh.

8. Triangular marsh south of railroad extending into Mill Cove. Needs two or three cross ditches. Area 11 acres.

9. Marsh on east side of Mill Cove. Area about 46 acres. East side of creek hay has been cut. Needs ditching, especially west of creek.

10. Marsh adjoining State Aviation Park—about 128 acres. On the west side of marsh part of the hay has been cut. Needs ditching. In the central portion of marsh about 20 acres probably well drained by natural creeks. Southwest corner either on or adjoining State property especially needs ditching.

The west half of the marsh south of the creek and owned by the State probably requires no ditching. The east half of the marsh owned by the State should be drained with ditches about 175 feet apart.

The outlet of the creek that drains this marsh (the northern boundary of the State property) is through the beach where it is in danger of filling up. While the outlet is adequate for good drainage, at the present it will require opening occasionally. The northern part of the marsh needs ditching.

11. Marsh south of Greens Farms railroad station. About 17 acres. This marsh is in fair shape but will require ditching.

12. Marsh near east boundary of Westport southwest of the mouth of Sasco Creek. Area 10 acres. Old ditches need cleaning and an occasional new ditch.

13. Marsh west side Sasco Creek. Area 20 acres. The area between the railroad and the highway on the south has been ditched. The area north of the railroad probably has been ditched but was not examined.

During the past season Mr. W. L. Searles of Rowayton, who was mainly responsible for carrying out the ditching in the towns of Norwalk and Darien, spent considerable time in interesting the people of Westport to raise funds for ditching these marshes. On August 21, the writer met Mr. Searles and visited some of the people interested in the work. More than one-half of the necessary funds were pledged and it is hoped that sufficient money will be available to carry out the work in the spring.

ENTOMOLOGICAL FEATURES OF 1917.

The winter was rather mild and the temperature did not go sufficiently low to kill the peach buds—or at least a large proportion were not killed. Spring came late, however, and the blossoming of fruit trees and other events in plant development were fully two weeks—and in some instances three weeks—behind the average season. Spring and early summer, therefore, were cold and wet. Seeds requiring a high temperature could not safely be planted until late in May or even in June. Rainfall was heavy until August 1st, and the remainder of the season it was light—somewhat below the normal. On account of stormy weather while fruit trees were in bloom, bees could not work the blossoms, consequently there was a poor set of apples in many orchards on account of lack of pollination. The young apples fell off from each fruit cluster by the handful, because the flowers had not been fertilized. There was much damage from rosy aphis, *Aphis sorbi* Kalt, and from the false red bug, *Lygidea mendax* Reut.

Though there were many egg-clusters of the tent-caterpillar, *Malacosoma americana* Fabr., there were few nests, and comparatively few caterpillars developed and produced adults. Consequently the egg-clusters will not be found abundantly on the trees this winter.

Canker worms did only a moderate amount of damage.

The first rose chafer observed was on June 18, and a few days later the beetles came in their usual numbers. The earliest date heretofore recorded for New Haven is June 9, and the beetles usually appear in abundance on June 12.

In truck gardens the cabbage root maggot caused the usual amount of damage.

Cut worms were not especially troublesome. The striped cucumber beetle, *Diabrotica vittata* Fabr., was very abundant and troublesome at the Station farm at Mt. Carmel, and squash bugs caused the usual amount of injury.

Wireworms were reported as seriously injuring tobacco in a number of fields, and later in the summer attacked potato tubers in the ground.

The wheat midge, *Contarinia tritici* Kirby, injured a field of rye in Yalesville, and caused slight damage to a field of winter wheat in Westport.

Perhaps the most prominent entomological feature of the season was the outbreak of the pink and green aphid, *Macrosiphum solanifolii* Ashmead, in potato fields all over the State. This pest appeared in July, and in most cases the plants were seriously infested before the insect was known to be present. Spraying with nicotine solution was practiced but the injury had already been done and the yield was greatly reduced, thus causing a loss of thousands of dollars for the whole state. There were fields here and there which were not attacked, but the pest was reported from every county in Connecticut, and the infestation was rather general. It was especially prevalent in New Haven County.

The elm leaf beetle was observed at several points, and seemed to be more prevalent, particularly along the shore, than for several years.

Tussock moths were unusually abundant. The white-marked tussock moth, *Hemerocampa leucostigma* S. & A., was perhaps even more abundant than in 1916. The white egg-clusters were in evidence on the trunks and branches of trees in the cities and

towns and the caterpillars injured the foliage. The hickory tussock moth, *Halisidota caryae* Harr., was more prevalent than since 1907. The tessellated tussock moth, *H. tessellaris* S. & A., was more abundant than I have ever seen it around New Haven, and late in the summer the caterpillars were crawling everywhere in company with those of the other two species just mentioned.

The fall webworm, *Hyphantria cunea* Dru., was also prevalent and its nests were seen on fruit, shade and woodland trees throughout the State.

In young orchards and nurseries, the red-humped caterpillar, *Schizura concinna* S. & A., and the yellow-necked caterpillar, *Datana ministra* Dru., were unusually abundant and could be seen feeding in clusters, often stripping the trees. The walnut caterpillar, *Datana integerrima* G. & R., was more prevalent than for several years and completely defoliated many black walnut, butternut and hickory trees in August.

Adults of the eight-spotted forester, *Alypia octomaculata* Fabr., were common in June, but there was no such stripping by the caterpillars observed or reported as took place in New Haven in 1916.

Grasshoppers and crickets were very abundant during August and September and devoured much of the second crop of hay in many fields.

The turnip aphid, *Aphis pseudobrassicae* Davis, appeared in a few turnip fields but caused no such destruction to turnips and kale as was the case in 1916.

The imported cabbage worm, *Pontia rapae* Linn., and the cabbage looper, *Autographa brassicae* Riley, were prevalent in all cabbage fields in late summer and riddled the leaves.

The apple maggot, *Rhagoletis pomonella* Walsh, continues to do its usual amount of damage.

The Bureau of Entomology of the U. S. Department of Agriculture at Washington has, during the year, established in Connecticut at Wallingford a field station for the study of deciduous fruit insects, to be conducted in co-operation with this Station. Mr. E. H. Siegler is in charge of this field station and it is planned to start work of an investigative nature on the tent-caterpillar, apple maggot, peach borer, and possibly certain other fruit insects which need to be studied under Connecticut conditions. It is hoped that the orchardists of the State may receive much benefit from these investigations.

The brown-tail moth has through the year been very scarce throughout the area supposed to be infested, and has not extended its range the usual distance westward. The towns were not required to spend any money in destroying nests as in 1916.

There was a marked increase in the number of infestations of the gipsy moth, apparently due to wind-spread in the spring of 1916, though this was not discovered until scouting was done the following winter. This increase was especially noticeable in the towns of Thompson, Putnam, Woodstock and Killingly, but also showed in Pomfret, Eastford, Brooklyn, Hampton and Canterbury.

A new peach pest, *Laspeyresia molesta* Busck, has appeared in Stamford and New Canaan. This insect is a small moth and the larva is a borer in the terminal twigs of peach trees in orchards. So far this insect has not been found in the nurseries of Connecticut.

The army worm, *Cirphis* (*Heliophila*) *unipuncta* Haw., was reported from Northford and Orange, but only a few caterpillars were seen and did no damage.

A leaf-roller, *Olethreutes hemidesma* Zell., was common on *Spiraea Van Houtei* in some parts of the State.

As regards anti-mosquito work, considerable progress was made during the year. The legislature amended the law, greatly improving it and providing for both new work and maintenance to be done by the State, and making a small appropriation for the purpose. Three-fourths of the cost of the maintenance is collected from the towns by the State Comptroller. The first part of the season was rainy, forming pools, and was favorable for breeding mosquitoes. Considerable new ditching work was done in New Haven, East Haven and Orange, and maintenance work in Branford, Guilford, Madison, New Haven and Fairfield was supervised by the State.

More detailed accounts of the principal features of this chapter will be found in the pages of this report.

MISCELLANEOUS INSECT NOTES.

A Sawfly Borer in Poplar. On September 25, 1916, Mr. Zappe collected some borers in small twigs of Lombardy poplar near Derby. On June 1, 1917, an adult emerged, which we recognized as *Janus abbreviatus* Say, a species not before recorded from Connecticut.

Sawfly Larvae on Austrian Pine. On August 2, 1916, Mr. Zappe collected some sawfly larvae on Austrian pine in a nursery in New Haven. The larvae live in silken tubes or webs, and spend the winter in cells in the ground. On June 7, 1917, adults emerged which have been identified by Mr. Rohwer as an undescribed species of *Itycorsia.*

Army Worm. The army worm, *Cirphis (Heliophila) unipuncta* Haw., which was prevalent in the State in 1914 (See Report of this Station for 1914, page 157), was reported from two places in 1917. Caterpillars were brought in from Northford and were observed in Orange. They were not abundant, only a few being noticed, and did no appreciable damage.

Long-Horned Beetle a Borer in White Pine. On September 22, 1916, Mr. Zappe collected some borers in white pine on the grounds of Mr. C. H. Sierman in Hartford. These borers were in the main stem in about the same place that one would expect to find the white pine weevil, though perhaps a trifle lower, and some of them tunneled into the center of the stem. These were placed in a breeding cage, and on June 10, 12 and 26 adults emerged. They proved to be *Monohammus titillator* Fabr.

Leaf Roller on Virginia Creeper. In 1916 the writer noticed several rolled leaves on a Virginia creeper on his front porch, and on August 27 collected a few specimens for the insectary. On June 18, 1917, there emerged a small black moth marked with white spots and known to entomologists as *Desmia funeralis* Hübn., of the family Pyralidae. This insect also feeds upon grape.

A Sawfly on Balsam Fir. On July 24, 1917, we received some sawfly cocoons, collected in Danielson by Mr. Davis on Balsam fir. The pupae were rather abundant, and much resembled those of *Diprion simile.* On August 6, adults began to emerge. Mr. S. A. Rohwer has identified the species as *Diprion abietis* Harr., which has been previously recorded from Connecticut.

Twig Borers in Sourwood, Dogwood and Azalea. While inspecting nurseries in August and September, 1916, Mr. Zappe found several twigs containing borers. At one nursery in New Haven a branch of the sorrel tree or sourwood, *Oxydendrum arboreum* was infested; at another he found an azalea stem tunneled; at a Hartford nursery a red-twig dogwood was attacked. As these twigs all contained the larvae, they were placed in separate cages in the insectary. During the last of May the adults emerged.

That from the dogwood was *Oberea tripunctata* Swed. Those from Azalea and *Oxydendrum* proved to be *O. tripunctata* var. *myops* Hald.

The Sinuate Pear Borer in Connecticut. On May 29, 1917, a piece of bark from a pear tree was received from Mr. G. S. Brown of Norwalk. Mr. Brown wrote that a worm had eaten under the bark all around the trees and the branches. Several trees were attacked. The work of the insect was probably that of the sinuate pear borer, *Agrilus sinuatus* Oliv., which has damaged pear trees in New Jersey for at least twenty years, but which has not before been reported from Connecticut. No good remedy has been found other than destroying the infested trees.

Harrisina americana on Virginia Creeper. On August 27, 1916, the writer gathered from a Virginia creeper vine a colony of small larvae feeding upon a leaf. The dorsal surface was striped crosswise with black and yellow bands, and there was a black line on the side of the body. Under surface was white. Adults emerging June 12, 1917, were *Harrisina americana* Harr., a small moth with narrow, smoky wings, belonging to the family Pyromorphidae. The food plants are grape and Virginia creeper.

A Pest of Wheat Middlings. On October 10, 1917, specimens were received from Mr. A. D. Jacot, R. F. D. Sandy Hook, of wheat middlings infested with some form of insect life. The sample was examined and the insects were found to be winged psocids (family Psocidae) and were identified by Mr. Nathan Banks as *Pterodela pedicularis* Linn., a species with a previous record of doing damage in various stored plant and animal products. Heat would be a satisfactory remedy.

Weevil in Evening Primrose. The evening primrose (*Œnothera biennis*), commonly regarded as a weed in waste fields, is a common inhabitant of orchards, growing around the borders, or in that portion between the cultivated strips, if clean cultivation is not practiced. In nurseries the plant is common and in one nursery at New Canaan nearly every plant was infested with grubs tunneling in the stem, the tunnels being shown on plate XXXI, b. Adults were reared October 23, and were identified as *Tyloderma foveolatum* Say, one of the weevils or snout beetles.

A Leaf Beetle on Peas. On July 20, 1917, larvae were brought to the Station which had been found feeding upon peas and wild morning glory at Triangle Farm, Wallingford. These somewhat

resembled the larvae of the squash lady-beetle, but were without spines. On July 30, adults were reared, and proved to be *Chelymorpha argus* Licht., a leaf beetle of the family Chrysomelidae. This beetle commonly feeds upon the wild morning glory (*Convolvulus*), and sometimes attacks milkweed (Asclepias) and raspberry, but I do not recall having seen it recorded as attacking peas.

The Cynthia Moth at Stonington. On September 10, 1917, a caterpillar of the Cynthia moth, *Philosamia cynthia* Drury, was received from Mr. Oscar Swallow of Stonington. This caterpillar pupated September 15. Mr. Swallow gave Mr. Zappe some cocoons collected November 11, 1917. The caterpillars feed upon the leaves of Ailanthus or Tree of Heaven. They are large, fleshy, green caterpillars bearing soft bluish protuberances. The adult has a wing-spread of four or five inches, ground color olive drab, with wings crossed by pink and white bands, and each wing bearing a transparent eye spot edged with yellow. The species is an importation from China, and has become fairly common in the vicinity of New York City. It has previously been reported from Greenwich, Conn.

Elm Leaf Beetle More Abundant. For several years the elm leaf beetle has been on the decrease in Connecticut so that in most towns along the coast spraying the elm trees has not been practiced and little injury has been done to the trees. In 1917, however, increased activities of this insect were noticed at several points. There were many riddled leaves in Fairfield and vicinity, and at Greenfield Hill many trees were entirely defoliated. Its ravages, though less marked, were noticed at Manchester and Saybrook. These observations indicate that the elm leaf beetle may again appear in devastating numbers, and the residents of each town should be on the watch, ready to spray before the trees are injured. One thorough application of lead arsenate (3 lbs. of the paste in 50 gal. of water) about June 1st will generally protect the foliage for the season.

Eggs of the European Lackey Moth or Tent-Caterpillar Intercepted on Nursery Stock from Holland. On November 16, 1916, while inspecting some imported nursery stock at the greenhouses of the M. A. Free Co., Stamford, Mr. Zappe found an egg-cluster of the European lackey moth or tent-caterpillar, *Malacosoma neustria* Linn., which had been brought over in the shipment from Boskoop, Holland. There were several kinds of plants in the

shipment, including a species of *Malus*, upon which the caterpillars are known to feed. This insect makes nests on the trees and the caterpillars feed upon the leaves of fruit and other deciduous trees in much the same manner as the tent-caterpillar and the forest tent-caterpillar in this country. Had this egg-mass not been intercepted, a colony might have started, from which this additional pest might have become established in this country.

Disappearance of Tent-Caterpillar. The tent-caterpillar, *Malacosoma americana* Fabr., which has been exceedingly abundant during the past four years, has almost entirely disappeared in Connecticut. Egg-clusters were fairly common and it was expected that nests would be seen here and there on apple and wild cherry as usual, though perhaps in fewer numbers. In many cases the eggs hatched and the young caterpillars began their nests. The nest building did not develop far, however, and very few caterpillars ever developed into pupae or adults. Consequently this insect will not be a pest to reckon with in 1918. The writer was informed of one locality in Windham County where the caterpillars hatched and the nests developed normally. Here many mature caterpillars were seen and possibly egg-clusters may now be there upon the twigs of the trees. But in most sections of the State this insect was scarce in 1917 and will probably be even more so in 1918. The reason for its disappearance cannot be explained here, but is probably the effect of parasites or other natural enemies. The tent-caterpillar fluctuates in abundance, and periodically about every ten or twelve years is extremely abundant. This period of abundance usually lasts two or three seasons but in the period just passed, it has been abundant for four, and in some sections for five years.

A Bark Miner of Apple Twigs. Several times during the past fifteen years correspondents have sent to the Station specimens of apple twigs with serpentine mines just under the epidermal layer and light brown in color, being rather conspicuous on the twigs. The writer has often observed and collected material of these mines and once obtained a flattened larva, which was mounted in balsam. All efforts to rear the adult failed though many trials were made. Recently, however, the life history of this insect has been worked out by Mr. Stuart C. Vinal, who has published

the result of his studies.* It proves to be the larva of a small moth, *Marmara (Gracilaria) elotella* Busck, originally described in 1909.† Several times each year twigs are received which contain these mines. Thus, on November 24, 1916, some were sent from Norwalk; January 2, 1917, Cos Cob; February 13, Norwichtown; February 20, Cheshire; March 5, South Norwalk; March 30, Norwich. The larva and the mined twigs are shown on plate XXX, b and c. Apparently little or no injury results from these mines as the cambium is not reached. Hence control measures are scarcely needed.

A Leaf-Roller on Spiraea: Olethreutes hemidesma Zell. When inspecting nursery stock in the town of Ellington, August 14, it was noticed that many of the terminal shoots of *Spiraea van houtei* had their leaves drawn and fastened together by silk threads. Inside some of these nests a larva was found; others were empty. These nests were more plentiful in Ellington than in any other nurseries in the State, though noticed in Manchester. They are shown on plate XXXI, a.

A number of the nests were gathered, brought to the Station and placed in cages in the insectary. On August 24 several adults had emerged, and were recognized as *Olethreutes hemidesma* Zell., a moth of the family Tortricidae. This moth has a wing-expanse of about five-eighths of an inch, is chocolate brown in color, with the basal portion of the wings more or less mottled and marked with narrow, white, sinuous transverse lines. It is shown on plate XXXI, b.

This insect will probably not become sufficiently abundant to seriously injure or disfigure the shrubs, but in case it does, spraying with lead arsenate may be practiced. The poison should be applied during July. Clipping off and burning the infested shoots will also help to control the insect and may be the only control measure necessary if one has only a few shrubs in danger of attack.

Abundance of Grasshoppers. During the summer of 1917 grasshoppers and crickets were unusually abundant, and did considerable damage by eating the second crop of grass in many fields. At the Station farm at Mt. Carmel, in the orchards where spraying experiments were conducted, around the nurseries which we inspected, and in other places visited in various parts

* Jour. Econ. Ent. Vol. 10, page 488, 1917.

† Proc. Ent. Soc. Wash. Vol. xi. page 102, 1909.

of the State, the conditions were similar. Both immature and mature grasshoppers were present and in many cases the results of their feeding were noticeable. There is some danger that they may do damage in these fields next year. Probably the best method of control is the poisoned bran mash, such as is recommended for cutworms. It may be prepared as follows:

Wheat Bran	25 lbs.
White Arsenic or Paris Green	1 lb.
Cheap Molasses	2 qts.
Lemons	3
Water	3½ gallons.

Mix the bran and poison together thoroughly while dry. Squeeze the juice of the lemons into the water and also add the pulp and rind cut in small pieces. Add the molasses and stir. Add this liquid slowly to the poisoned bran and mix thoroughly. When finished, this mash is rather dry and easy to spread. To kill grasshoppers it should be sown or scattered about over the infested fields.

An Injurious Weevil Attacking Red Pine. *On August 11, 1917,* Mr. A. E. Moss, Assistant Forester, sent to the Station from Norfolk a section of the main trunk of a red or Norway pine about four inches in diameter which had been weeviled, even below the surface of the ground, and killed. The cells contained larvae and pupae which seemed somewhat larger than those of the white pine weevil, which kills the leaders of white pine trees throughout the Northeastern States. Moreover, the trunk or stem in this case was much larger and had thicker bark than the favorite point of attack of the white pine weevil. The red pine trunk was photographed and placed in breeding cages. On August 20, several adults had emerged, and Mr. Walden identified the species as *Pissodes approximatus* Hopkins, described in Technical Series No. 20, page 49, Bureau of Entomology, U. S. Department of Agriculture. The adult resembles the white pine weevil, but is a trifle larger, with markings more prominent, and wing covers more strongly narrowed posteriorly. It is shown on plate XXXI, c, and its work on plate XXXII.

Such attacks would finally kill the trees. Apparently only an occasional tree is attacked. In the red pine plantations of the

State Experimental Forest at Rainbow no such attack has ever been observed. A few years ago similar injury to a young stone pine was noticed in one of the nurseries, and the tree sent to the Station. All weevils had emerged, however, and nothing enlightening could be learned about it. At present, destroying the infested trees seems to be about the only control measure to be recommended.

Wheat Midge Injuring Rye in Connecticut. In response to a complaint, Mr. Zappe visited the field of Mr. George E. Hough at Yalesville, Town of Wallingford, on June 25, 1917. About half of a rye field containing about four acres produced no kernels in the heads, though plants and heads were otherwise well formed and thrifty. The other half sown two weeks later gave a good yield. This difference was sharply marked and could be detected from a distance, the injured field ripening and the straw turning yellow earlier than the uninfested field. A careful examination of the empty heads revealed the cause of the failure. Small reddish maggots were present in the hull where each kernel should be. These are the larvae of a small, two-winged fly known as the wheat midge, *Contarinia tritici* Kirby, a species first observed in England in 1795, and first noticed in America near Quebec in 1819, and in northern Vermont in 1820. About 1828 this insect had increased to such an extent that the wheat crop was abandoned in many localities in northern New England. Every few years until about 1860, this insect caused severe injury, the most serious being in 1854, when Dr. Asa Fitch, then State Entomologist of New York, estimated the injury to amount to $15,000,000.00 in New York State alone. Serious damage was also done in 1857 and 1858.

There is probably but one brood each year, though some evidence has been produced to show that in certain seasons in some parts of the country there is a partial second brood.

Though wheat is usually the crop damaged, sometimes rye, barley, and oats are injured by this insect. Considerable damage to rye in 1917 was reported from certain portions of New York State.

Specimens of the same insect in winter wheat were received at this office on July 18 from Westport. The infested stalks were much shorter than the normal stalks. The adult is a small, two-winged fly which appears about the middle of June and lays

its eggs in a groove at the summit of the chaff. The eggs hatch in about a week and the maggots burrow into the kernels which are then forming. The maggots are of a reddish color and the insect is sometimes known as the "red weevil." The larvae enter the ground to pupate.

Dr. Felt states that there are no satisfactory control measures, but Sanderson advises burning the stubble, deep fall plowing and a rotation of crops.

Note Regarding Authorship.

For bibliographical purposes, all matter in this report (Bulletin 203) should be credited to W. E. Britton, unless otherwise indicated.

Illustrations.

All plates are from photographs. Plate I, b, is by I. W. Davis; XVII, b; XXI, b and c; and XXIII, c, by the late H. A. Doty; XVIII by Mr. Tuttle; XIX, a, by the late D. B. Pangburn; XXI, d, by J. B. Rorer; XVI, a, by the late Professor M. V. Slingerland; XXV, c, by Professor Z. P. Metcalf of the North Carolina Station; X, a, and XI, by Messrs. Houser, Guyton and Lowry of the Ohio Station; I, a; IV, c; V; XVI, b; and XIX, b, c and d, are by W. E. Britton; II, b; III, a; VII; X, b; XII, b and c; XIII; XIV, b; XXIV; XXV, a; XXVI, b, c and d; XXVII, b and c, by M. P. Zappe. All others are by B. H. Walden.

Figure 1 was reproduced from a drawing by A. E. Moss: figure 3 by B. H. Walden; figures 2 and 4 are from Chittenden, Bureau of Entomology, U. S. Department of Agriculture.

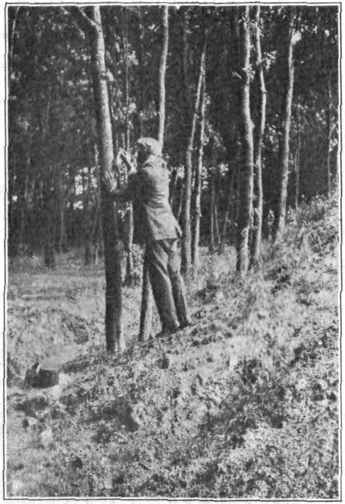
INDEX

Abbott's Sawfly, 237
Acremoniella atra, 241
Acronycta rumicis, 242
Adalia bipunctata, 298
Aedes cantator, 352
sollicitans, 352
Agrilus sinuatus, 361
Aleyrodes, 242
Allograpta obliqua, 299
Alypia octomaculata, 358
Ameloctonus oedemisiae, 330
Anarsia lineatella, 318
Anastatus bifasciatus, 250, 251
Angoumois grain moth, 337, 344
Ant, 312, 339, 344
Little red or Pharaoh's, 234, 235, 309, 314
Anthrenus verbasci, 338
Apanteles hyphantriae, 323
lacteicolor, 250, 251, 323, 329
Aphid, Apple, 235, 259
Green, 259
Rosy, 259, 356
Peach, Green, 293
Potato, 236, 290, 357
Spinach, 293
Spruce gall, 237
Turnip, 358
Woolly, 242
Aphidius polygonaphis, 299
rosae, 299
Aphis pomi, 259
pseudobrassicae, 358
sorbi, 259, 356
Apiaries, Inspection, 235, 242
Apple Aphids, 235, 259
Borer, 237
Maggot, 358
Red-bug, False, 234, 235, 259, 356
Army Worm, 359, 360
Ascomycetes, 242
Ash Borer, 237
Attagenus piceus, 339
Autographa brassicae, 358
Bark Miner, 363
Bean Weevil, Common, 333, 340, 343, 344
Four-spotted, 333
Beetle, Bacon, 339
Cabinet, Large, 338, 344
Small, 338, 344
Calosoma, 250
Carpet, Black, 338, 344
Cigarette, 339, 344
Cucumber, 234, 262, 357
Drug Store, 334, 343
Elm Leaf, 357, 362
Flour, Confused, 334, 343
Rust-red, 334, 343
Grain, 331
Saw-toothed, 334, 341, 344
Ground, 323
Ham, Red-legged, 339, 344
Lady, Convergent, 298
Glacial, 298
Nine-spotted, 298
Parenthesis, 298
Red, 298
Spotted, 298
Thirteen-spotted, 298
Two-spotted, 298
Larder, 339, 344
Blatta corticum, 306
indica, 306
melanocephala, 306
punctata, 306
surinamensis, 306
Blight, Chestnut, 237
Book Louse, 339, 344
Borer, Apple, 237
Ash, 237
Lilac, 237
Linden, 237
Peach, 358
Twig, 318
Pear, Sinuate, 361
Sawfly, 359
Shot-hole, 237
Twig, 360
Brachyacantha ursina, 299
Brown-tail Moth, 234, 235, 246, 247, 359
Bruchus obtectus, 333
pisorum, 332
quadrimaculatus, 333
Cabbage Looper, 358
Root Maggot, 357
Worm, Imported, 358
Cabinet Beetle, Large, 338, 344
Small, 338, 344
Cadelle, 332, 343
Calandra granaria, 335
oryzae, 335
Calosoma Beetle, 250
Calosoma frigidum, 265
scrutator, 323
sycophanta, 250, 252
Campoplex fugitivus, 323
oedemisiae, 330
pallipes, 323
Canker, Poplar, 237
Worms, 357
Carpet Beetle, Black, 338, 344
Caterpillar, Red-humped, 237, 329, 358
Tent, 252, 357, 358, 362, 363
Walnut, 326, 358
Yellow-necked, 328, 358
Celatoria diabroticae, 267
Cerambycobius, 283
Cheese Skipper, 339, 344
Chelymorpha argus, 362
Chestnut Blight, 237
Chrysopa, 299
Cigarette Beetle, 339, 344
Cirphis unipuncta, 359, 360
Cistela melanocephala, 263
Coccinella novemnotata, 298, 299
sanguinea, 298
Cockroach, 234, 235, 302, 339, 344
Australian, 304
Codling Moth, 261
Colletotrichum lagenarium, 264
Compsilura concinnata, 250
Confused Flour Beetle, 334, 343
Contarinia tritici, 357, 366
Crickets, 358, 364
Crioceris vittata, 263
Crown Gall, 241
Cryptocephalus americanus, 263
Cucumber Beetle, 234, 236, 262, 357
Curculio, 261
Cutworms, 310, 357
Cycloneda munda, 298
Cynthia Moth, 362
Darker Meal Worm, 332
Datana integerrima, 326, 358
ministra, 237, 328, 358
Delomerista, 283
Dermestes lardarius, 339
Desmia funeralis, 360
Diabrotica longicornis, 266
12-punctata, 266
vittata, 262, 357

Dibrachoides verditer, 283, 284, 287
Dibrachys boucheanus, 323
  nigrocyaneus, 283, 284, 287
Diprion abietis, 360
  pini, 274, 276, 285, 287, 288, 289, 290
  simile, 234, 235, 273
Drug Store Beetle, 334, 343
Eight-spotted Forester, 358
Elm Leaf Beetle, 357, 362
  Scale, 237
Emphytus cinctus, 242
Empusa, 299
  gryllii, 323
Entomopthora, 299
  aphidis, 300, 301
Ephestia kuehniella, 337
Equipment, New, 235, 247
Eremotylus glabratum, 323
European Grain Moth, 338, 344
  Lackey Moth, 241, 362
Eurytoma, 283
Euschistus servus, 323
Exobasidium vaccinii, 241
Exorista petiolata, 283
Expenditures, 231, 232
Fall Web-worm, 237, 319, 324, 325, 358
Flour Beetle, Confused, 334, 343
    Rust-red, 334, 343
  Moth, 335
    Mediterranean, 337, 344
Fly, Lace-wing, 298, 299
  Syrphid, 298, 299
Forester, Eight-spotted, 358
Four-spotted Bean Weevil, 333
Galeruca, 263
Gipsy Moth, 234, 235, 246, 248, 359
Glomerella cingulata, 242
Gracilaria elotella, 364
Grain Beetle, 331
    Saw-toothed, 334, 341, 344
  Moth, 337, 344
    Angoumois, 337, 344
    European, 338, 344
Granary Weevil, 335, 344
Grasshoppers, 358, 364
Green Apple Aphis, 259
Ground Beetle, 323
Halisidota caryae, 325, 358
  maculata, 325, 326
  tessellaris, 325, 326, 358
Ham Beetle, Red-legged, 339, 344
Harrisina americana, 361
Heliophila unipuncta, 359, 360
Hemerocampa leucostigma, 326, 357
Hemiteles utilis, 283
Heterocordylus malinus, 259
Heteropelma datanae, 329
Hickory Tussock Moth, 325, 358
Hippodamia convergens, 298, 299
  glacialis, 298
  parenthesis, 298
  xiii-*punctata*, 298
Hyphantria budea, 322
  cunea, 319, 358
  punctatissima, 319, 322
  textor, 319, 320
Indian Meal Moth, 335, 344
Inspection, Apiaries, 235, 242
  Imported Nursery Stock, 240
  Nurseries, 236
  Summary of, 232
Isaria farinosa, 250
Itycorsia, 360
Janus abbreviatus, 359
Juniper Web-worm, 237
Lace-wing Fly, 298, 299
Lackey Moth, European, 241, 362
Lady Beetle, 298
  Convergent, 2
  Glacial, 298
  Nine-spotted,
  Parenthesis, 298
  Red, 298
  Spotted, 298
  Thirteen-spotted, 298
  Two-spotted, 298
Larder Beetle, 339, 344
Laemophlaeus pusillus, 335
Lasioderma serricorne, 339
Laspeyresia molesta, 315, 359
Leaf Beetle, Elm, 357, 362
  Hoppers, 237
  Miner, 242
    Peach, 237
  Roller, 359, 360, 364
    Oak, 237
Lecanium, 237
Leucophaea surinamensis, 302, 306
Lilac Borer, 237
Limneria pallipes, 323
Lina japonica, 237
  scripta, 237
Linden Borer, 237
Lophyrus similis, 273, 288
Lygidea mendax, 259, 356
Lygocerus, 299
Macrosiphum solanifolii, 290, 357
Macrosporium, 241
Maggot, 261
  Apple, 358
  Cabbage Root, 357
Malacosoma americana, 252, 357, 363
  neustria, 241, 242, 362
Mantis, Praying, 323
Marmara elotella, 364
Meal Moth, 335
    Indian, 335, 344
  Snout Moth, 337, 344
  Worm, Common, 331, 343
    Darker, 332
Mediterranean Flour Moth, 337, 344
Megilla fuscilabris, 298
  maculata, 298
Meteorus communis, 328
  hyphantriae, 323
  versicolor, 251
Midge, Wheat, 357, 366
Miner, Bark, 363
  Leaf, 242
    Peach, 237
Mite, 339, 344
  Pear Leaf Blister, 237
Monodontomerus dentipes, 283, 284, 287
Monohammus titillator, 360
Monomorium pharaonis, 234
Mosquito Work, in Connecticut, 1917, 45, 359
  Law, 345
  Branford, 351, 352
  East Haven, 350
  Fairfield, 354
  Guilford, 351, 352
  Hamden, 351
  Madison, 351, 353
  New Haven, 348
  Orange, 350
  Westport, 354
Moth, Brown-tail, 234, 235, 246, 247, 359
  Codling, 261
  Cynthia, 362
  European Lackey, 241, 362
  Flour, Mediterranean, 337, 344
  Gipsy, 234, 235, 246, 248, 359
  Grain, Angoumois, 337, 344
    European, 338, 344
  Hickory Tussock, 325, 358
  Meal, Indian, 335, 344
    Snout, 337, 344
  Peach, 318
  Tessellated Tussock, 325, 326, 358
  White-marked Tussock, 237, 325, 326, 357
Myzus persicae, 293

Necrobia rufipes, 339
Nurseries, Firms Receiving Certificates, 237
Inspection 236
Oak Leaf Roller, 237
Scale, Pit-making, 237
Oberea tripunctata, 361
var. *myops*, 361
Olethreutes hemidesma, 359, 364
Oyster Shell Scale, 237, 242
Pachyneuron, 283
aphidivorum, 299
Panchlora celebesa, 306
occipitalis, 306
submarginata, 306
surinamensis, 306
Pea Weevil, 332, 343, 344
Peach Aphid, 293
Borer, 358
Leaf Miner, 237
Moth, 318, 359
Scale, West Indian, 237
Twig-Borer, 318
Pear Borer, Sinuate, 361
Leaf Blister Mite, 237
Periplaneta australasiae, 304
Pernoplasmopara cubensis, 264
Pestalozzia guepini, 242
Pharaoh's Ant, 234, 235, 314
Philosamia cynthia, 362
Phyllosticta, 242
Pine Blister Rust, White, 236
Leaf Scale, 237
Sawfly, European or Imported, 234, 235, 237, 273
Weevil, 365
Piophila casei, 339
Pissodes approximatus, 365
Pit-making Oak Scale, 237
Plochionis timidus, 323
Plodia interpunctella, 335
Podisus maculiventris, 323
Pontia rapae, 358
Poplar Canker, 237
Potato Aphid, 236, 290
Prionidus cristatus, 323
Pseudomonas tumifaciens, 241
Psocids, 361
Pterodela pedicularis, 361
Pteromalus, 283
boucheanus, 323
Publications of Entomological Department, 232
Pycnoscelus obscurus, 306
surinamensis, 234, 302
Pyralis farinalis, 337
Receipts, 231
Red-bug, False Apple, 234, 259, 356
True, 259
Red-humped Caterpillar, 237, 329, 358
Rhagoletis pomonella, 358
Rice Weevil, 335, 344
Root Maggot, Cabbage, 357
Rose Chafer, 357
Scale, 237
Rosy Apple-Aphis, 259, 356
Rust, White Pine Blister, 236
Rust-red Flour Beetle, 334, 343
San Jose Scale, 237
Sawfly, Abbott's, 237
European Pine, 234, 235, 237, 273
Saw-Toothed Grain Beetle, 334, 341, 344
Scale, Elm, 237
Oak, Pit-making, 237
Oyster Shell, 237, 242
Peach, West Indian, 237
Pine Leaf, 237
Rose, 237
San Jose, 237
Scurfy 237
Tulip Tree, 237
Schedius kuvanae, 250
Schizura concinna, 329, 358
Scurfy Scale, 237
Shot-hole Borer, 237
Silvanus surinamensis, 334
Sitodrepa panicea, 334
Sitotroga cerealella, 337
Skipper, Cheese, 339, 344
Soldier Bugs, 323
Sowbugs, 312
Sphaerophoria cylindrica, 299
Spinach Aphid, 293
Spruce Gall Aphid, 237
Squash Bugs, 357
Staff, Entomological, 233
Stagmomantis carolina, 323
Striped Cucumber Beetle, 234, 262, 357
Syntomosphyrum esurus, 323
Syrphid Fly, 298, 299
Syrphus americana, 299
Tachina, 323
Telenomus bifidus, 323
Tenebrio molitor, 331
obscurus, 332
Tenebrioides mauritanicus, 332
Tent Caterpillar, 252, 357, 358, 362, 363
Tessellated Tussock Moth, 325, 326, 358
Tinea granella, 338
Tribolium confusum, 334
ferrugineum, 334
Troctes divinatorius, 339
Trogoderma tarsale, 338
Tulip Tree Scale, 237
Turnip Aphid, 358
Tussock Moth, Hickory, 325, 358
Tessellated, 325, 326, 358
White-marked, 237, 325, 326, 357
Twig Borers, 360
Tyloderma foveolatum, 361
Tyroglyphus, 339
Walnut Caterpillar 326, 358
Web-worm, Fall, 237, 319, 324, 325, 358
Juniper, 237
Weevil, Bean, Common, 333, 340, 343, 344
Four-spotted, 333
Granary, 335 344
Pea, 332, 343, 344
Pine Red, 365
Red, 367
Rice, 335, 344
West Indian Peach Scale, 237
Wheat Midge, 357, 366
Wheel Bug, 323
White-marked Tussock Moth, 237, 325, 326, 357
Wireworms, 357
Woolly Aphis, 242
Work, Chief Lines, 235
Yellow-necked Caterpillar, 328, 358
Zygobothria nidicola, 250

PLATE I.

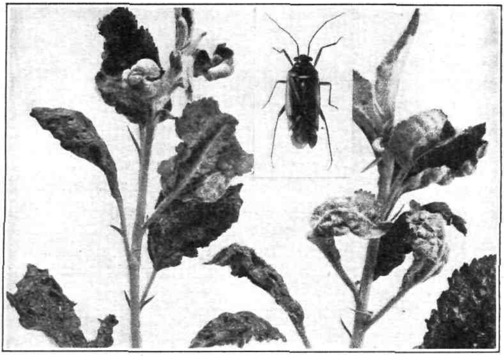


a. Planting a colony of parasities. Groton.

b. Spraying to kill gipsy moth caterpillars.

GIPSY MOTH WORK.

PLATE II.

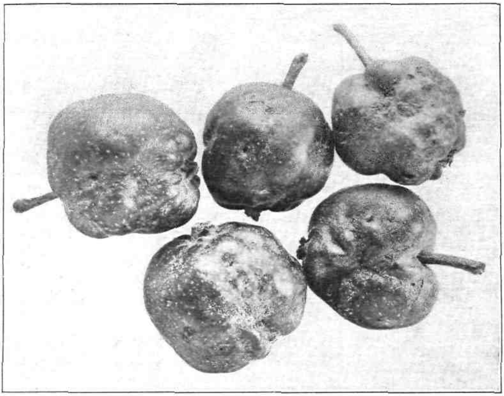


a. Apple leaves injured by the false red bug.
Leaves natural size, bug nearly three times enlarged.

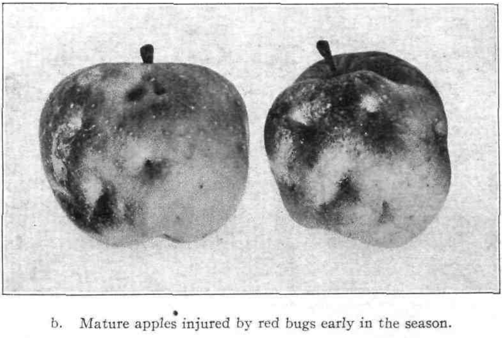
b. Spraying to kill aphis and red bug.
Smith's orchard, Clintonville.

FALSE RED BUG.

PLATE III.



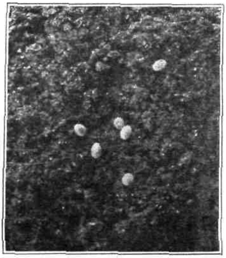
a. Half-grown apples showing red bug injury.



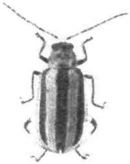
b. Mature apples injured by red bugs early in the season.

FALSE RED BUG.

PLATE IV.



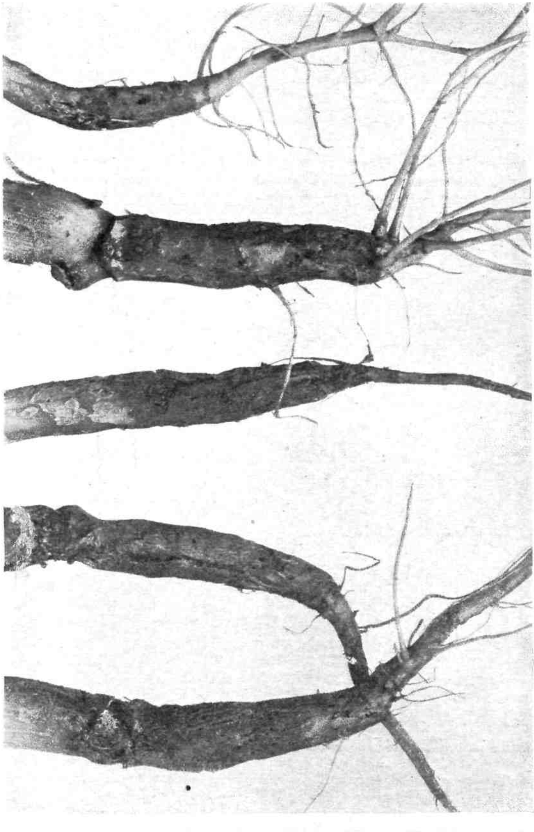
a. Eggs, as laid in the soil.
Five times enlarged.



b. Striped cucumber beetle.
Enlarged four times.

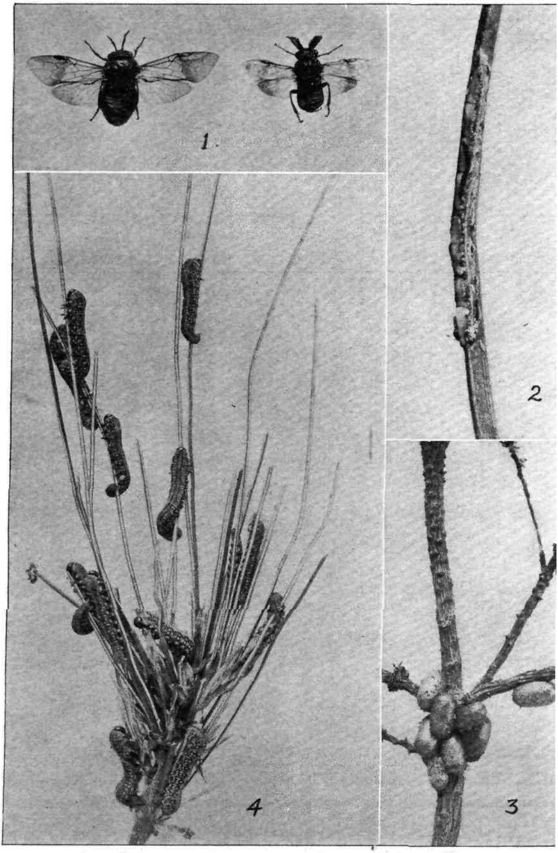
c. View at farm showing protectors over cucumber plants

STRIPED CUCUMBER BEETLE.



Cucumber plants injured by the larvae of the striped beetle.
Natural size.

PLATE VI.

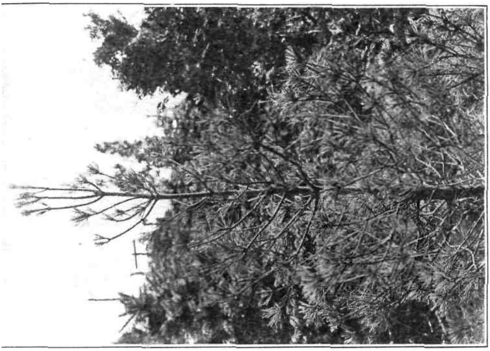


1. Adults, female and male, twice natural size; 2. Eggs in pine needle, about four times enlarged; 3. Cocoons, natural size; 4. Larvae feeding on pine, natural size.

IMPORTED PINE SAWFLY.

Diprion simile: Hartig.

PLATE VII.

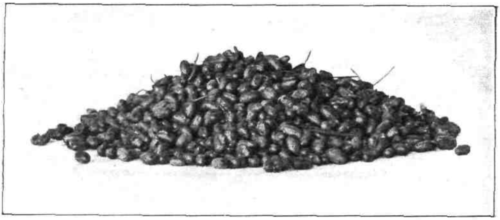


a. Japanese or Bhotan pine, *Pinus excelsa*, partially stripped by larvæ.

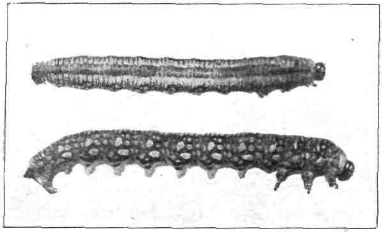
b. *Pinus cembra* about seven feet tall almost defoliated by larvæ.

IMPORTED PINE SAWFLY.

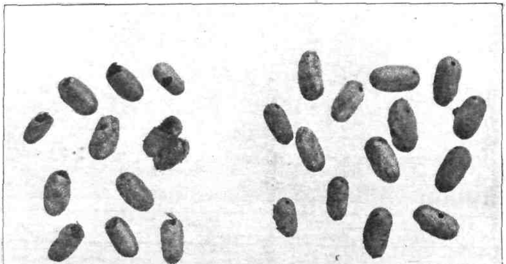
PLATE VIII.



a. A heap containing 1,617 cocoons, collected from pine twigs.



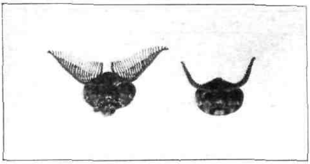
b. Dorsal and lateral view of larva, twice enlarged.



c. Cocoons at left have been torn open, probably by birds; those at right show exit holes of Chalcid parasite. Natural size.

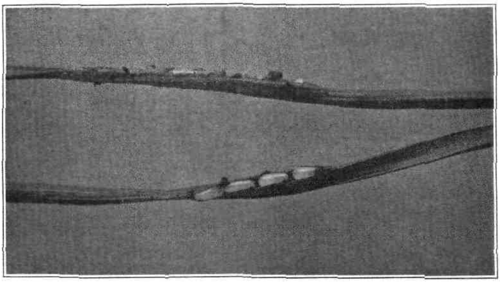
IMPORTED PINE SAWFLY.

PLATE IX.

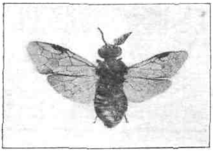


a. Male and female antennae. Four times enlarged

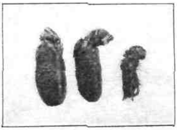
b. *Old cocoons* with new ones made inside them. Twice natural size.



c. Eggs laid in pine needles, four times enlarged.



d. Gynandromorph, left side like female, right like male. Twice enlarged.

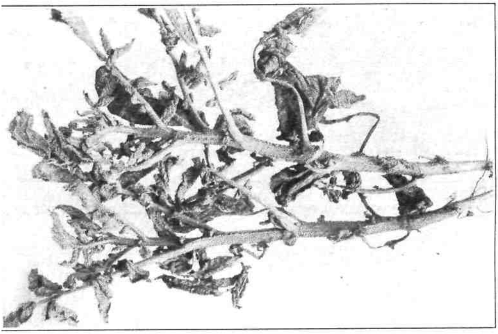


e. *Tachinid parasites* which were unable to escape from cocoons. Twice enlarged.

IMPORTED PINE SAWFLY.

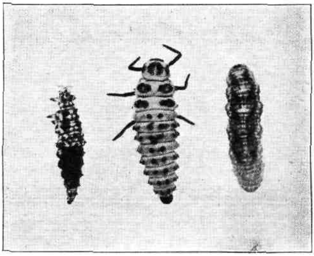
PLATE X.

a. Growing tip of tomato badly infested with aphids. (After Houser, Guyton and Lowry, Ohio Agr. Expt. Sta., Bull. 317.)



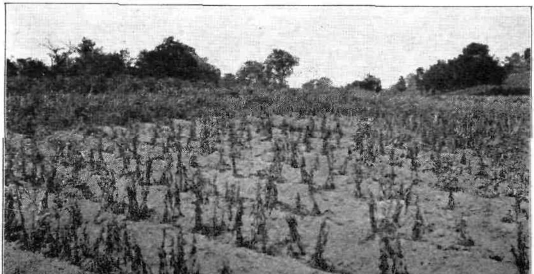
b. Potato plant injured by aphids.

POTATO APHID.



1 2 3

a. Three important predaceous enemies of the pink and green potato aphid. 1. Larva of lace-wing fly; 2. Lady beetle larva; 3. Larva of Syrphus fly. (After Houser, Guyton and Lowry, Ohio. Agr. Expt. Sta., Bull. 317.)

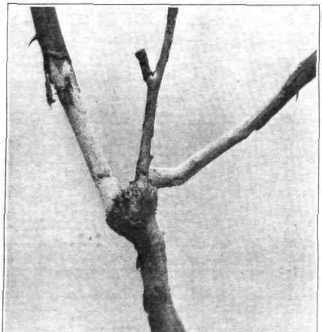


b. Potatoes killed by pink and green potato aphid, Hamilton County, Ohio (June 30, 1917.) (After Houser, Guyton and Lowry, Ohio Agr. Expt. Sta., Bull. 317.)

POTATO APHID.

PLATE XII.

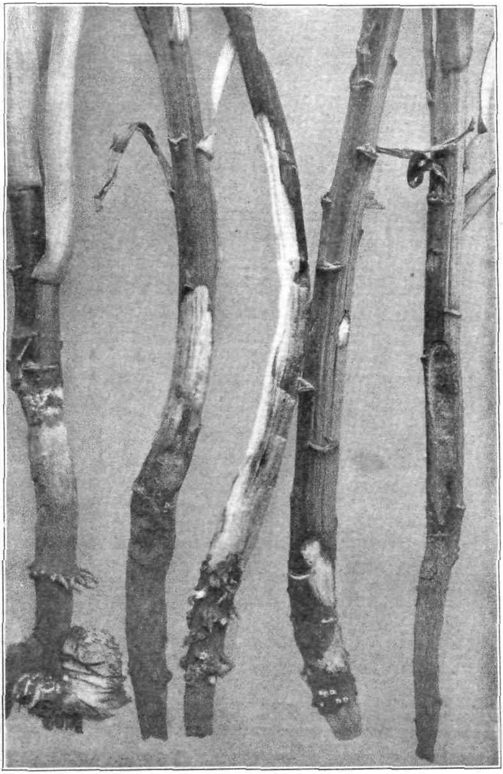
a. View in greenhouse, where cockroaches injured plants, Cromwell.



b. Rose plant with bark eaten off by cockroaches Natural size.

c. Egg-sac of cockroach. Twice enlarged.

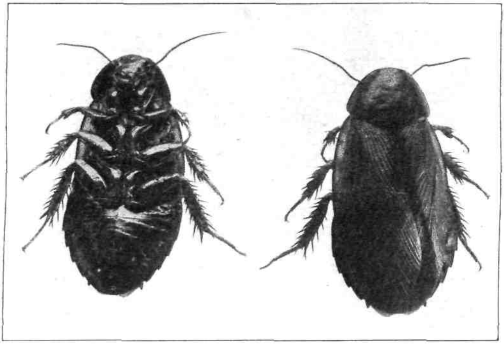
AN EXOTIC COCKROACH.



Easter lilies with bark and roots eaten by cockroaches. Natural size.

AN EXOTIC COCKROACH.

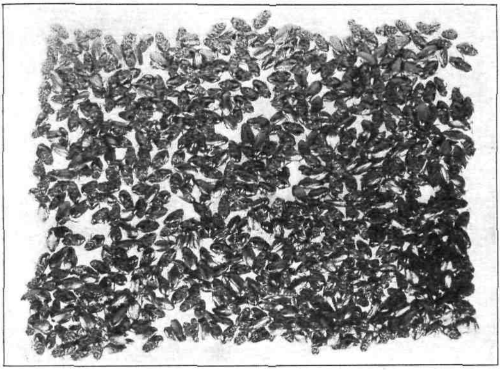
PLATE XIV.



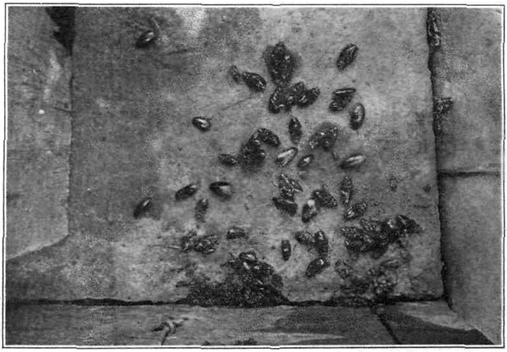
a. Adult female, ventral and dorsal view. Enlarged three times.

b. Holes in newspaper where cockroaches ate the cyanide bait.
No dead roaches were found.

AN EXOTIC COCKROACH.



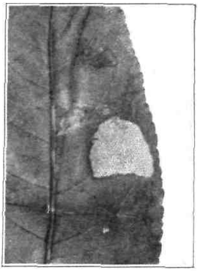
a. 708 dead cockroaches.



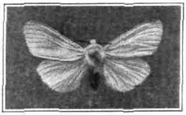
b. View looking downward in one of the walks, showing roaches killed by kerosene spray.

AN EXOTIC COCKROACH.

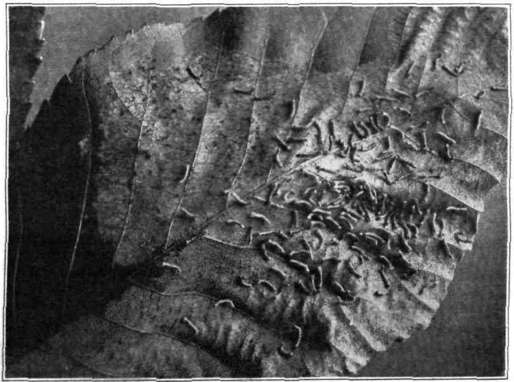
a. Nests of fall web-worm. (After Slingerland.)



b. Egg-cluster on peach leaf. Natural size.

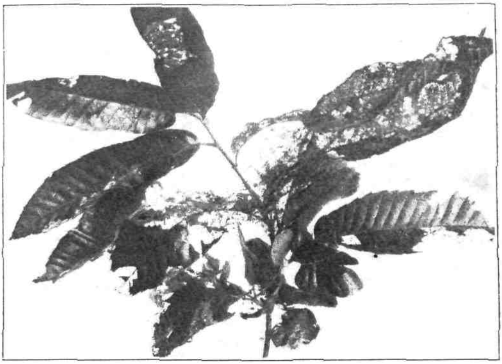


c. Adult female, natural size.

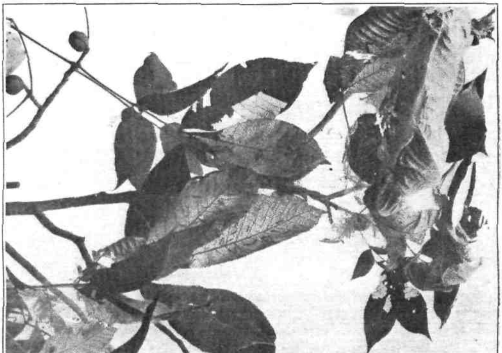


d. Young larvæ feeding on hickory leaf. Natural size.

FALL WEB-WORM.



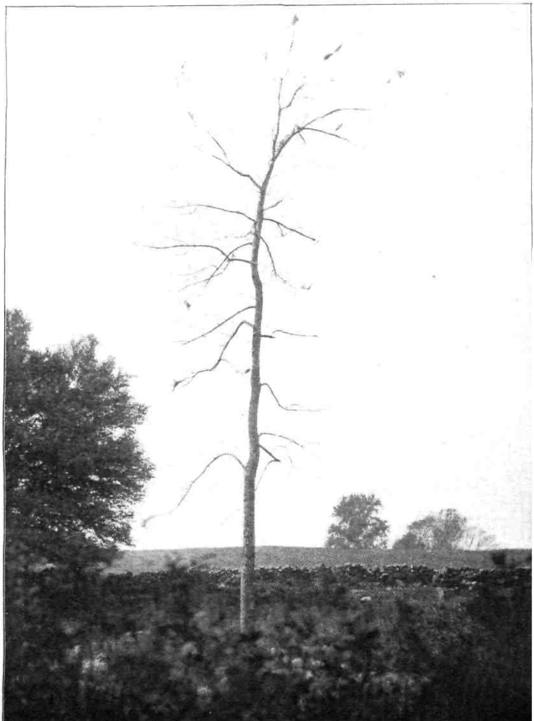
a. Nest on chestnut.



b. Nest on hickory.

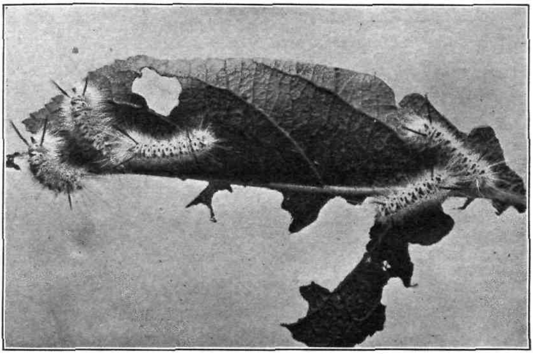
FALL WEB-WORM.

PLATE XVIII.



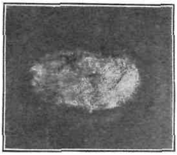
Hickory tree defoliated by the fall web-worm. New Canaan.

FALL WEB-WORM.

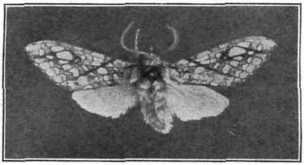


a. Penultimate stage of caterpillars. Natural size.

. Fully-grown caterpillar on leaf.
Natural size.



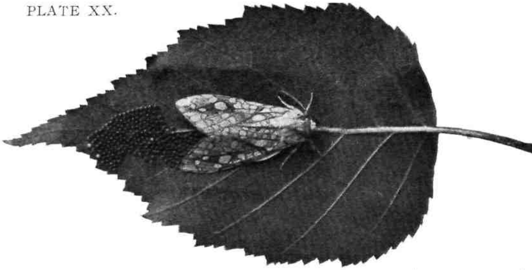
c. Cocoon. Natural size.



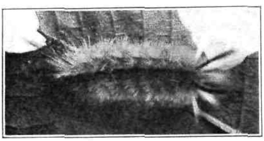
d. Adult. Natural size.

HICKORY TUSSOCK MOTH.

PLATE XX.



a. Female and egg-cluster of hickory tussock moth. Natural size.

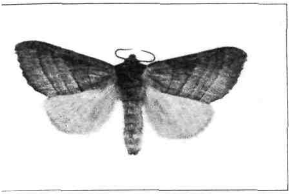


b. Larva of tessellated tussock moth. Natural size.

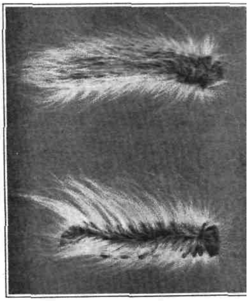
c. Trunk of maple tree showing tussock moth cocoons.

d. Young walnut caterpillars on hickory leaf. Natural size.

TUSSOCK MOTHS.



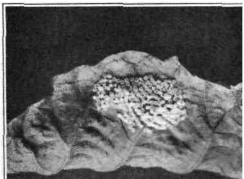
a. Adult female. Natural size



b. Mature larva. Natural size.

c. Pupæ. Natural size.

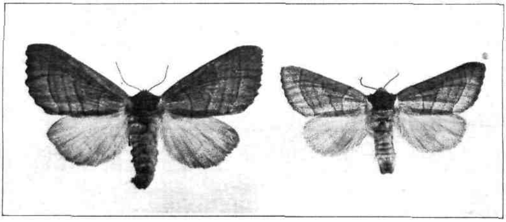
d. Cast skins on tree trunk.



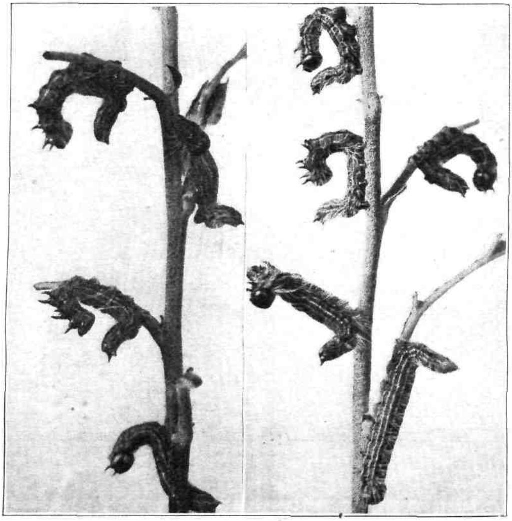
e. Egg-cluster. Natural size.

WALNUT CATERPILLAR

PLATE XXII.

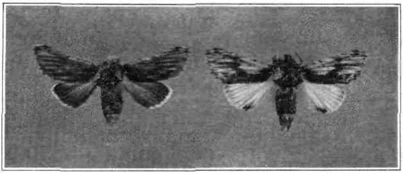


a. Adult female and male. Natural size.

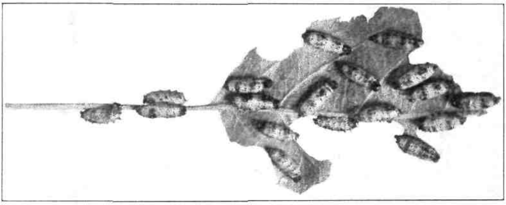


b. Caterpillars on apple twigs. Natural size.

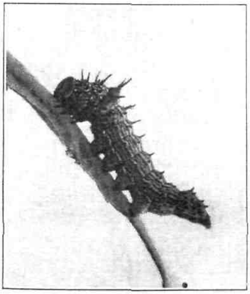
YELLOW-NECKED CATERPILLAR.



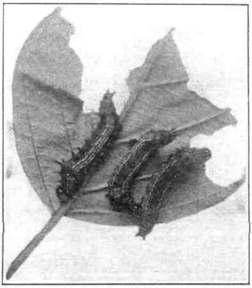
a. Adult female and male. Natural size.



b. Parasitized caterpillars. Natural size.



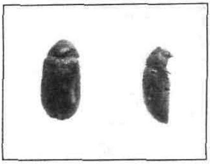
c. Mature caterpillar. Enlarged one and one-half times.



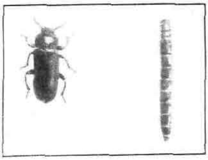
d. Young caterpillars. Natural size.

RED-HUMPED CATERPILLAR.

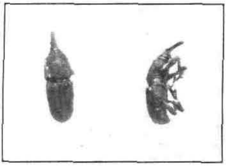
PLATE XXIV.



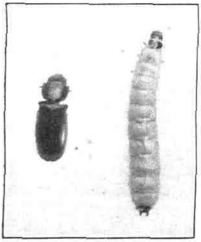
a. Drug store beetle. Adults. Four times enlarged.



b. Common meal worm, adult and larva. Natural size.



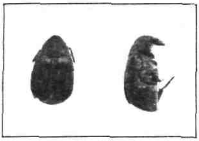
c. *Rice weevil. Adults.* Four times enlarged.



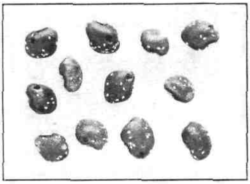
d. Cadelle, adult and larva. Twice natural size.

e. Pea weevil, adult beetle. Four times enlarged.

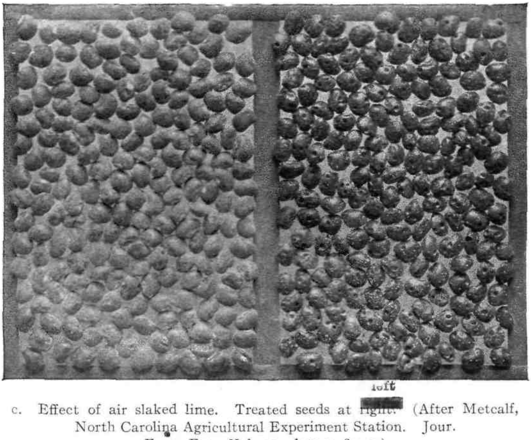
INSECTS ATTACKING STORED FOOD PRODUCTS.



a. Common bean weevil. Adult beetles. Four times enlarged.



b. Infested cow peas, showing eggs and exit holes of bean weevil. Natural size.

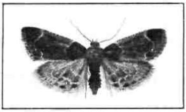


left

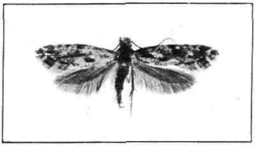
c. Effect of air slaked lime. Treated seeds at [redacted] (After Metcalf, North Carolina Agricultural Experiment Station. Jour. Econ. Ent., Vol. 10, plate 3, fig. 2.)

BEAN WEEVIL.

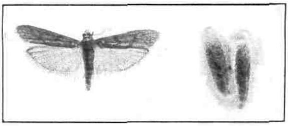
PLATE XXVI.



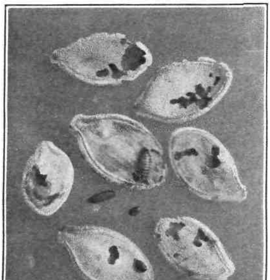
a. Meal snout moth.
Natural size.



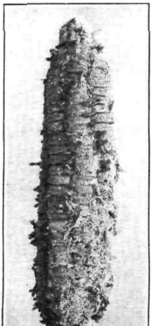
b. European grain moth.
Three times enlarged.



c. Mediterranean flour moth and cocoons, slightly enlarged.

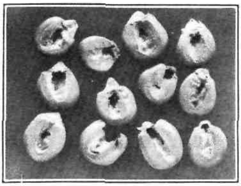


d. Seeds injured by the large cabinet beetle. Natural size.

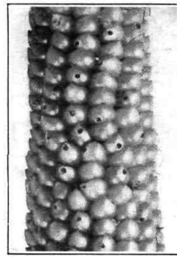


e. Ear of corn injured by the European grain moth. Half size.

INSECTS INJURING STORED FOOD PRODUCTS.

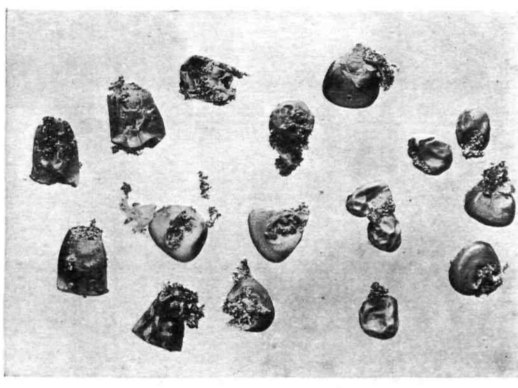


a. Peruvian seed corn injured by saw-toothed grain beetle. Reduced one-half.



b. *Pop corn showing exit* holes of Angoumois grain moth. Natural size.

c. Saw-toothed grain beetle. Four times enlarged.

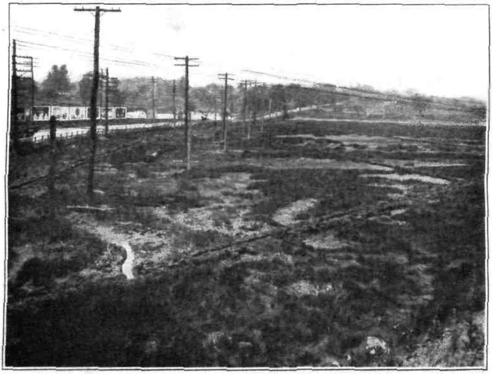


d. Kernels of corn injured by the Indian meal moth. *Natural size.*

INSECTS INJURING STORED FOOD PRODUCTS.

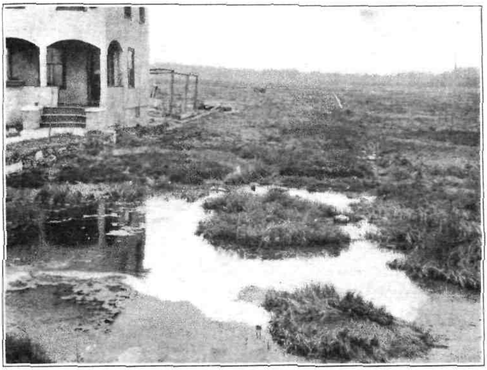
PLATE XXVIII.

a. View in Quinnipiac Marsh, New Haven, before ditching.

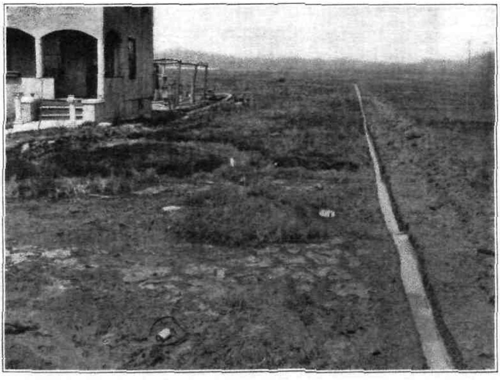


b. Same view, after ditching.

MOSQUITO ELIMINATION WORK.



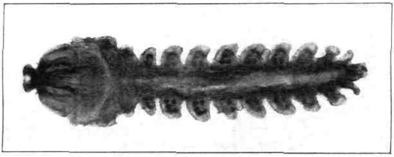
a. View in Old Field Creek Marsh, West Haven, before ditching.



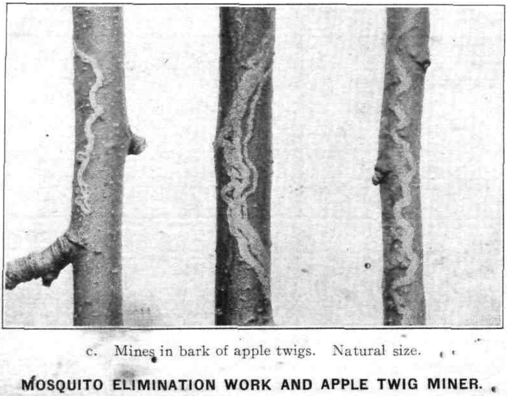
b. Same view, after ditching.

MOSQUITO ELIMINATION WORK.

a. View in Quinnipiac marsh, showing workmen cleaning old ditch.

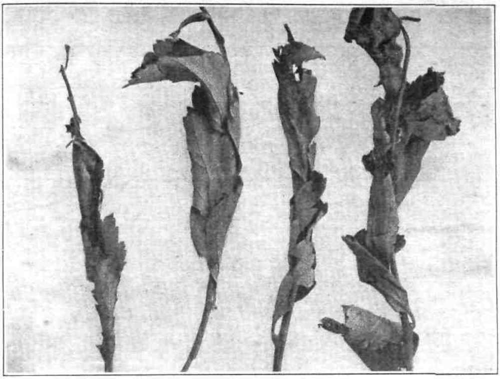


b. Larva of apple twig miner. Enlarged twelve times.

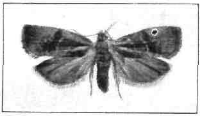


c. Mines in bark of apple twigs. Natural size.

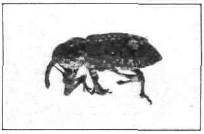
MOSQUITO ELIMINATION WORK AND APPLE TWIG MINER.



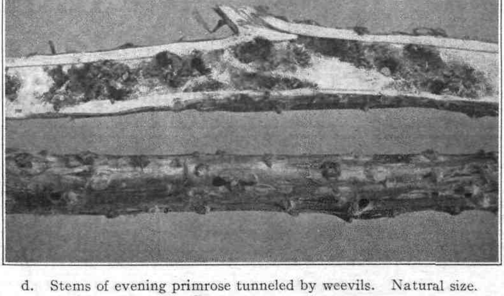
a. Larval nests of spiræa leaf roller. Natural size.



b. Adult of spiræa leaf roller. Twice enlarged.



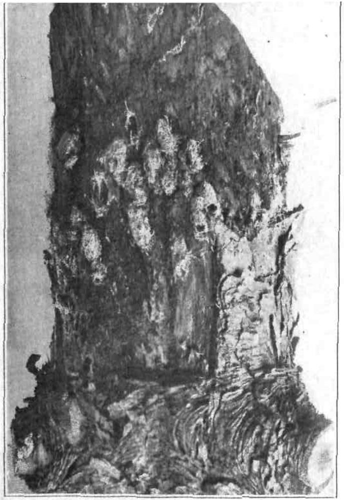
c. Larger pine weevil. Four times enlarged.



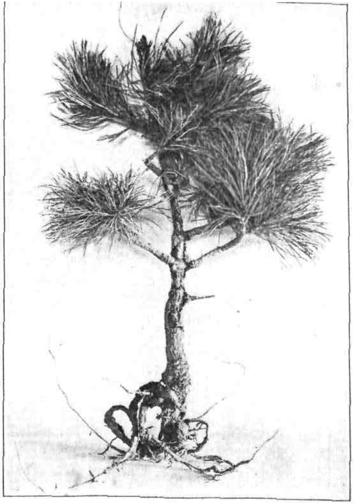
d. Stems of evening primrose tunneled by weevils. Natural size.

SPIRAEA LEAF ROLLER: LARGER PINE WEEVIL: INFESTED STEMS OF EVENING PRIMROSE.

PLATE XXXII.



a. Pupal cells in trunk of red pine.



b. Young stone pine, *Pinus cembra*, from nursery, injured by weevils.

WORK OF THE LARGER PINE WEEVIL.

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 204 FEBRUARY, 1918

Fertilizer Report for 1917

By E. H. JENKINS, *Director and*
JOHN PHILLIPS STREET, *Chemist*
In Charge of the Analytical Laboratory

CONTENTS

	Page
Raw Materials Chiefly Valuable for Nitrogen	375
" " " " " Phosphoric Acid	379
" " " " " Potash	383
" " " " " Nitrogen and Phosphoric Acid	384
Nitrogenous Fertilizers, Factory Mixed	386
Miscellaneous Fertilizers	416

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Report on Commercial Fertilizers, 1917.

By E. H. Jenkins, *Director, and* John Phillips Street,
Chemist in Charge of the Analytical Laboratory.

During 1917 forty-four individuals and firms have entered for sale in this state 410 brands of fertilizers classified as follows:

Nitrogenous superphosphates with potash	167
Nitrogenous superphosphates without potash	160
Bone manures and tankage	34
Fish, blood, castor pomace and chemicals	49
Total	410

During the spring months V. L. Churchill, the sampling agent of the Station, visited about 100 towns and villages of the state and gathered samples of commercial fertilizers. These represented all the brands registered with the exception of the following:

Alpha Portland Cement Co.'s Alpha Potash-Lime Fertilizer; *American Agricultural Chemical Co.'s* Dissolved Acid Phosphate, H. G. Acid Phosphate, Grain and Seeding Fertilizer, Odorless Grass and Lawn Top Dressing Revised, Monarch Potato Manure, Great Harvest Potato Special, Lion Brand Potato Manure, Bradley's Eclipse Phosphate 1916, Bradley's Extra Potato and Root Special, Bradley's Northland Potato Grower, Bradley's Complete Manure for Top Dressing Grass and Grain, Bradley's Triplex Potato Special. East India Economizer Phosphate 1916, East India Pilgrim Fertilizer 1916, East India Mayflower 1916, Quinnipiac Corn Manure 1916, Quinnipiac Phosphate 1916, Williams and Clark's Royal Phosphate 1916, Williams and Clark's Matchless Fertilizer 1916; *Apothecaries Hall Co.'s* Victor Corn Phosphate; *Bowker's* Superphosphate with Ammonia 1%, Stockbridge Complete, Potato Phosphate 1916, Complete Alkaline Tobacco Grower 1916; *Clark's* Special Mixture; *Coe Mortimer's* Extra Special Potato Fertilizer Revised, 12% Blood Tankage; *James'* Ground Bone; *Lister's* Buyer's Choice Acid Phosphate, Valley

Brand Fertilizer 1916, Celebrated Tobacco Fertilizer; *Manchester's* 14% Acid Phosphate, Fine Ground Bone, Ground Tankage 9-20; *National* Ammoniated Phosphate 1916, Excelsior Potato Fertilizer, H. G. Top Dressing 1916.

A sample of the American Agricultural Chemical Co.'s Grain and Seeding Fertilizer, sent by a purchaser, was analyzed.

Classification of Fertilizers Analyzed.

1. *Containing nitrogen as the chief active ingredient:*	
Nitrate of soda	9
Cotton seed meal	95
Castor pomace	8
2. *Containing phosphoric acid as the chief active ingredient:*	
Basic lime phosphate	4
Precipitated bone phosphate	6
Precipitated phosphate	1
Acid phosphate	17
Phospho plaster	1
Barium phosphate	1
3. *Containing potash as the chief active ingredient:*	
Muriate of potash	3
Cotton hull ashes	1
4. *Containing nitrogen and phosphoric acid:*	
Fish manures	12
Tankage	13
Bone manures	21
5. *Mixed fertilizers:*	
Nitrogenous superphosphates with potash	147
Nitrogenous superphosphates without potash	198
6. *Miscellaneous fertilizers and waste products:*	
Sheep manure	6
Wood ashes	20
Household wastes	28
Limestone	5
Miscellaneous	29
Total	625

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF SODA, OR SODIUM NITRATE.

As offered in the Connecticut market this year, nitrate of soda has contained an average of 15.44 per cent. of nitrogen, equivalent to 93.6 per cent. of pure sodium nitrate.

The following nine samples were analyzed:

9364. Sold by Apothecaries Hall Co., Waterbury. Sampled at factory.

8944. Sold by Sanderson Fertilizer & Chemical Co., New Haven. Stock of C. R. Treat, Orange.

8947. Sold by Wilcox Fertilizer Co., Mystic. Sampled at factory.

9333. Sold by Coe-Mortimer Co., New York City. Stock of J. E. Stoddard, Abington.

9331. Sold by Berkshire Fertilizer Co., Bridgeport. Stock of C. Buckingham, Southport.

8939. Sold by American Agricultural Chemical Co., New York City. Stock of G. S. Phelps & Co., Thompsonville.

9352. Sold by L. T. Frisbie Co., New Haven. Sampled at factory.

8942. Sold by Nitrate Agencies Co., New York City. Stock of E. B. Palmer, Bridgeport.

9361. Sold by F. S. Royster Guano Co., Baltimore, Md. Stock of A. W. Anderson, Northford.

ANALYSES OF NITRATE OF SODA.

Station No.	**9364**	**8944**	**8947**	**9333**	**9331**	**8939**	**9352**	**8942**	**9361**
Per cent. of									
Nitrogen guaranteed	15.00	15.00	15.00	15.00	14.80	15.00	15.00	15.00	15.00
Nitrogen found	15.52	15.20	15.48	15.44	15.32	15.34	15.34	15.56	15.78
Cost per ton	$70.00	70.00	73.00	73.00	85.00	88.00	90.00	....	90.00
Nitrogen costs cents per pound	**22.6**	**23.0**	**23.6**	**23.6**	**27.7**	**28.7**	**29.3**	....	**28.5**

The cost of nitrogen in nitrate of soda in small lots at retail has been on the average 26 cents per pound, 1 1-2 cents more than last year, and 9 or 10 cents more than in 1915.

The supply has been so small, however, and the rise in price as the season advanced has been so rapid that average figures have little significance.

COTTON SEED MEAL.

Ninety-five samples of this material, bought for use as a fertilizer, have been tested. Most of the samples represent car lots.

Of the 69 samples which came to the laboratory with guaranties, 26 contained the claimed amount of nitrogen and require no detailed report here. On the other hand, 43, or 62 per cent. of the guaranteed samples, were deficient in nitrogen. The analyses of these samples are given in the table.

The deficiencies were not quite so great in amount as last year ranging from 0.10 to 0.81 per cent., with an average in the 43 samples of 0.30 per cent. Based on the average cost of nitrogen in cotton seed meal, as determined below, these deficiencies would warrant a rebate of from 53 cents to $4.29 per ton, a considerable item when the meal is purchased in car lots.

The ninety-five samples contained from 5.37 to 7.20 per cent. of nitrogen, with an average of 6.10 per cent. The average cost per ton, in the 79 samples where the price was furnished, was $44.20, about $5.50 higher than last year.

Assuming 2.9 and 1.9 as the respective percentages of phosphoric acid and potash in the meal, if they are valued at 4 cents and 25 cents per pound, respectively, the nitrogen of cotton seed meal in the ninety-five samples cost on the average 26.5 cents per pound, 5.6 cents higher than last year. This is equivalent to $5.30 per unit.

Most of the purchasers report that where the nitrogen in the meal was less than guaranteed they had little difficulty in securing rebates.

In our judgment the rebates did not fully compensate for the deficiency where not more that $4.00 per unit was allowed. Certainly, at present prices of meal, $5.30 per unit is none too high a rebate.

Cotton Seed Meals Below Guaranty.

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled, or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	Apothecaries Hall Co., Waterbury.				
8746	17264	K. C. Kulle, Suffield	5.83	6.17	$39.00
8747	27058	" " "	5.70	6.17	39.00
8748	14897	" " "	5.83	6.17	39.00
	F. W. Brode & Co., Memphis.				
9337		E. N. Austin, Suffield	5.90	6.38	43.00
8888		" " "	5.92	6.38	43.00
8743	77066	K. C. Kulle, Suffield	5.86	6.17	39.00
8744	36777	" " "	6.07	6.17	39.00
8745	26551	" " "	6.00	6.17	39.00
	C. L. Campbell & Co.				
9205		Farmers' Co-op. Asso., Woodstock	6.05	6.17	45.50
	E. Crosby & Co., Brattleboro, Vt.				
9105	27351	D. J. Sullivan, Suffield	6.07	6.18	43.50
	S. P. Davis, Little Rock, Ark.				
8750		S. F. Brown, Windsor	6.05	6.17	39.00
	East St. Louis Cotton Oil Co.				
8805	92365	R. Smith, Poquonock	5.69	6.17	39.00
	Rodney J. Hardy & Sons				
9102	R. S. 5	Geo. S. Phelps & Co., Thompsonville	5.55	5.76	46.00
	Humphreys-Godwin Co.				
9252	105511	E. S. Seymour, Suffield	5.80	6.18	43.00
9112	50492	Spencer Bros., Suffield	5.95	6.18	43.00
9111	171212	" " "	5.55	6.18	43.00
9110	5136	" " "	5.37	6.18	43.00
9108	84575	" " "	6.02	6.18	44.75
9107	45934	" " "	5.84	6.18	44.75
9106	240265	" " "	5.86	6.18	43.00
9103	45240	" " "	5.96	6.18	44.00
9022	98855	S. J. Orr, W. Suffield	5.97	6.17	.....
8847	14575	F. D. Lawton & Son, Unionville	5.75	6.17	.....
8781	13556	Spencer Bros., Suffield	6.04	6.18	39.00
8761	37750	Olds & Whipple, Hartford	6.44	6.56	50.00
8762	550565	" " "	6.39	6.56	50.00

COTTONSEED MEALS BELOW GUARANTY.—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled, or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	Poe Cottonseed Products Co., Memphis.				
9046	....	Amer. Sumatra Tob. Co., Hartford	6.05	6.17	.....
	J. E. Soper Co., Boston.				
8780	20769	Spencer Bros., Suffield	5.98	6.18	$39.00
	Southern Cotton Oil Co., Memphis.				
9163	28087	Conn. Tobacco Corp., Silver Lane	5.70	6.17	44.50
9164	60770	" " " " "	5.92	6.17	44.50
9013	133895	" " " " "	5.81	6.17	44.50
9014	24948	" " " " "	5.78	6.17	44.50
9015	151067	" " " " "	5.78	6.17	44.50
9016	151064	" " " " "	5.73	6.17	44.50
9017	151049	" " " " "	5.78	6.17	44.50
9012	151072	" " " " "	5.74	6.17	44.50
8823	36238	" " " " "	5.91	6.17	44.50
8824	151059	" " " " "	6.01	6.17	44.50
8802	16002	" " " " "	5.97	6.17	44.50
	Union Seed & Fert. Co.				
9158	40656	John Sullivan & Son, Suffield	6.00	6.17	42.50
	Virginia-Carolina Chem. Co. N. Y. City.				
9458	27871	Conn. Tobacco Corp., Silver Lane	5.46	5.76	46.00
9459	36400	" " " " "	5.42	5.76	46.00
9460	87114	" " " " "	5.52	5.76	46.00

CASTOR POMACE.

This is a residue from the manufacture of castor oil and is used chiefly as a tobacco fertilizer. Experience indicates that it is a little slower in its action than cotton seed meal and that it gives a somewhat heavier quality to the tobacco leaf. Stock will eat it greedily if they have the chance, but it is extremely poisonous.

The following eight samples were analyzed:

8940. Sold by American Agricultural Chemical Co., New York City. Stock of C. F. Allen, Warehouse Point.

8871. Sold by Apothecaries Hall Co., Waterbury. Sampled and sent by Karl C. Kulle, Suffield.

9330. Sold by Apothecaries Hall Co., Waterbury. Stock of W. J. Reeves, Windsorville.

9350. Sold by Baker Castor Oil Co., New York City. Stock of Olds & Whipple, Hartford.

9332. Sold by Berkshire Fertilizer Co., Bridgeport. Stock of W. N. Pinney, Rockville.

9390. Sold by Coe-Mortimer Co., New York City. Stock of M. C. Griffin, East Granby.

9360. Sold by Olds & Whipple, Hartford. Stock of J. N. Lasbury, Broad Brook.

8945. Sold by Spencer Bros., Suffield. Sampled at factory.

ANALYSES OF CASTOR POMACE.

Station No.	**8940**	**8871**	**9330**	**9350**	**9332**	**9390**	**9360**	**8945**
Per cent. of								
Nitrogen guaranteed	4.53	5.00	4.52	4.50	4.52	4.53	5.00	4.84
Nitrogen found	4.65	3.45	4.61	4.75	4.71	4.66	5.06	4.91
Cost per ton	$32.25	32.00	34.00	31.00	31.00	28.00	32.00	30.00

In sample **9350** one per cent. each of phosphoric acid and potash was guaranteed; the sample contained 1.46 per cent. of phosphoric acid but only 0.45 per cent. of water-soluble potash.

Sample **8871** was 1.55 per cent. deficient in nitrogen.

The average nitrogen content of the samples was 4.60 per cent. and the average cost per ton, $31.28.

Assuming a value of 4 cents per pound for phosphoric acid and 25 cents per pound for potash, the average cost of nitrogen per pound in castor pomace this year was 27.3 cents, or $5.46 per unit.

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

BASIC LIME PHOSPHATE.

Shipments of basic phosphate from abroad have been almost cut off on account of the war. As a substitute for basic phosphate a product called "basic lime phosphate" has been put on the market, of which we have analyzed four samples of two brands. "Available phosphoric acid" was determined by the so-called Wagner method.

9367. Basic Lime Phosphate. Sold by American Agricultural Chemical Co., New York City. Stock of C. R. Main, Norwich.

9469. Same brand as **9367.** Stock of W. P. Chipman & Son, Talcottville.

9370. Basic Fruit and Legume Phosphate. Sold by Coe-Mortimer Co., New York City. Stock of Willis Smith, Winsted.

9434. Same brand as **9370.** Stock of A. T. Henry, Wallingford.

ANALYSES OF BASIC LIME PHOSPHATE.

Station No.	**9367**	**9469**	**9370**	**9434**
Per cent. of				
Total phosphoric acid	*14.29*	*14.10*	*14.02*	*15.65*
"Available" phosphoric acid guaranty	13.00	12.00	13.00	13.00
"Available" phophoric acid found	11.81	11.71	12.28	13.13
Cost per ton	....	$22.00	....	15.00

One sample of each brand contained less "available" phosphoric acid than was guaranteed.

PRECIPITATED BONE PHOSPHATE.

This is a manufacturing by-product and consists of fine precipitated phosphate of lime, neutral in reaction, and contains no nitrogen. It is very readily soluble in ammonium citrate solution and is quickly available to crops. It is at present chiefly used as a tobacco fertilizer.

Six samples were analyzed, all of which were sold by Olds and Whipple, Hartford. **9371** was sampled by the Station at the factory, and **9373** by the Station from the stock of F. T. Phelps, Suffield; **8711, 8712** and **8742** were sampled and sent by the seller; **8872** was sampled and sent by Karl C. Kulle, Suffield. The respective car numbers for the last four samples were 88300, 73792, 4822 and 73365.

The guaranty for the material was 28 per cent. "available" and 32 per cent. total phosphoric acid.

ANALYSES OF PRECIPITATED BONE PHOSPHATE.

Station No.	**9371**	**9373**	**8711**	**8712**	**8742**	**8872**
Per cent. of						
Water-soluble phosphoric acid	1.56	1.33	1.41	1.37	1.01	1.50
Citrate-soluble phosphoric acid	29.98	27.98	28.67	28.44	30.65	29.10
Citrate-insoluble phosphoric acid	8.02	7.61	6.00	6.49	8.64	7.02
Total phosphoric acid	39.56	36.92	36.08	36.30	40.30	37.62
"Available" phosphoric acid	31.54	29.31	30.08	29.81	31.66	30.60

The above samples sold at the rate of $1.40 to $1.50 per unit of "available" phosphoric acid, or from 7.0 to 7.5 cents per pound.

PRECIPITATED PHOSPHATE.

9369. Sold by Berkshire Fertilizer Co., Bridgeport. Stock of W. N. Pinney, Rockville. Cost $30.00 per ton. Guaranteed 22 per cent. "available" phosphoric acid. It contained

Water-soluble phosphoric acid	5.43
Citrate-soluble phosphoric acid	18.78
Citrate-insoluble phosphoric acid	0.95
Total phosphoric acid	25.16
"Available" phosphoric acid	24.21

"Available" phosphoric acid cost 6.2 cents per pound.

DISSOLVED ROCK PHOSPHATE OR ACID PHOSPHATE.

This material is made by treating mineral phosphates or phosphate rock with oil of vitriol (sulphuric acid), which converts the larger part of the phosphoric acid into forms soluble in water, and at the same time changes into sulphate of lime a large part of the lime which was previously combined with phosphoric acid.

The guaranty usually gives the percentage of "available" phosphoric acid. This is only a trade name for the sum of the water-soluble and citrate-soluble phosphoric acid. Its amount gives no certain indication of the actual availablity of this phosphoric acid to crops. In acid phosphate, however, well made from domestic rock, it is fair to assume that the larger part of the "available" is also agriculturally available.

The following seventeen samples were analyzed:

9353. Sold by E. Manchester & Sons, Winsted. Stock of H. H. McKnight, Ellington.

9328. Sold by L. T. Frisbie Co., New Haven. Stock of H. G. Cooke, Branford.

9356. Sold by Virginia-Carolina Chemical Co., New York City. Stock of Tanner & Wilcox, Winsted.

8943. Sold by Nitrate Agencies Co., New York City. Stock of Edward White, Rockville.

9324. Sold by Armour Fertilizer Works, Chrome, N. J. Stock of Edward White, Rockville.

8816. Sold by L. T. Frisbie Co., New Haven. Sampled and sent by F. W. Browning, Norwich.

8938. Sold by American Agricultural Chemical Co., New York City. Stock of L. F. Burr, Branford.

9322. Sold by American Agricultural Chemical Co., New York City. Stock of J. A. Glasnapp, West Cheshire.

8946. Sold by Wilcox Fertilizer Co., Mystic. Sampled at factory.

8937. Sold by American Agricultural Chemical Co., New York City. Stock of L. F. Burr, Branford.

9327. Sold by Coe-Mortimer Co., New York City. Stock of J. E. Stoddard, Abington.

9351. Sold by L. T. Frisbie Co., New Haven. Sampled at factory.

9321. High Grade Soluble Phosphate. Sold by Coe-Mortimer Co., New York City. Stock of Joseph Humphreys, Danbury.

9326. Soluble Phosphate. Sold by Bowker Fertilizer Co., New York City. Stock of A. R. Manning, Yantic.

9355. Sold by F. S. Royster Guano Co., Baltimore, Md. Stock of W. Howard, Windsor.

8941. Sold by Apothecaries Hall Co., Waterbury. Sampled at factory.

8760. Plain Superphosphate. Sold by Sanderson Fertilizer & Chemical Co., New Haven. Sampled and sent by A. B. Smith, Clintonville. Suspected of containing added lime. 27.88 per cent. was present, not an abnormal amount.

ANALYSES OF ACID PHOSPHATE.

Station No.	Water-soluble phosphoric acid.	Citrate-soluble phosphoric acid.	Citrate-insoluble phosphoric acid.	Total phosphoric acid.	"Available" phosphoric acid *found*.	"Available" phosphoric acid guaranteed.	Cost per ton.	"Available" phosphoric acid costs cents per pound.
9353	13.87	3.87	1.39	19.13	17.74	16.0	$18.50	5.2
9328	13.36	2.31	0.74	16.41	15.67	14.0	17.00	5.4
9356	15.96	1.77	0.27	18.00	17.73	16.0	19.00	5.4
8943	15.41	1.29	0.86	17.56	16.70	16.0	18.50	5.5
9324	14.83	1.64	0.52	16.99	16.47	16.0	18.50	5.6
8816	16.42	1.15	0.29	17.86	17.57	16.0	20.00	5.7
8938	14.29	2.81	0.82	17.92	17.10	16.0	21.00	6.1
9322	11.02	6.71	0.64	18.37	17.73	18.0	22.50	6.3
8946	15.05	2.22	0.13	17.40	17.27	16.0	22.00	6.4
8937	9.48	5.85	0.79	16.12	15.33	14.0	20.00	6.5
9327	12.71	3.96	0.36	17.03	16.67	16.0	22.00	6.6
9351	15.92	1.25	0.78	17.95	17.17	16.0	23.00	6.7
9321	10.84	4.70	0.49	16.03	15.54	14.0	22.00	7.1
9326	9.96	4.79	0.50	15.25	14.75	14.0	24.00	8.1
9355	13.03	3.41	0.36	16.80	16.44	16.0	....	..
8941	12.44	2.10	0.50	15.04	14.54	14.0	....	..
8760	....	....	....	17.00	....	....	....	..

One of the above samples was guaranteed 18 per cent. "available"; ten were guaranteed 16 per cent., and five 14 per cent.

The average cost of "available" phosphoric acid in the above samples was 6.2 cents per pound, about 0.75 cents less than last year.

PHOSPHO PLASTER.

9368. Sold by American Agricultural Chemical Co., New York City. Stock of A. L. Burdick, Westbrook. Guaranteed 2 per cent. "available" phosphoric acid. It contained

Water-soluble phosphoric acid	2.03
Citrate-soluble phosphoric acid	2.63
Citrate-insoluble phosphoric acid	2.21
Total phosphoric acid	6.87
"Available" phosphoric acid	4.66
Lime (calcium oxid)	31.93

BARIUM-PHOSPHATE.

9408. Sold by Witherbee, Sherman & Co., Port Henry, N. Y. Stock of Station Farm, Mt. Carmel. Guaranteed 14 per cent. phosphoric acid, 7 per cent. barium sulphid.

It contained 15.34 per cent. phosphoric acid, chiefly in insoluble forms.

III. RAW MATERIALS OF HIGH GRADE CONTAINING POTASH.

Owing to the war very little, if any, potash has been shipped to this country during the past three years. The three samples of muriate of potash analyzed represented stock in the hands of farmers who were tempted by the abnormally high prices to dispose of their surplus stock.

MURIATE OF POTASH.

8691, 8692. Stock of Samuel Wilson, Waterbury. They contained 53.92 and 52.44 per cent. of potash, respectively.

8801. Stock of W. T. Peters, Cheshire. It contained 58.24 per cent. of potash.

COTTON HULL ASHES.

9279. Sold by Olds and Whipple, Hartford. Car No. 22120; stock of Windsor Tobacco Growers Corporation, Windsor. Cost $6.00 per unit of water-soluble potash, equivalent to 30 cents per pound for actual potash. It contained 24.78 per cent. of potash.

IV. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN AND PHOSPHORIC ACID.

FISH MANURES.

The twelve samples analyzed show considerable uniformity in the content of nitrogen, which ranges from 7.28 to 9.75 per cent., with an average of 8.34 per cent. The phosphoric acid, however, shows a wide range, from 2.75 to 10.41 per cent., with an average of 6.77 per cent. Six of the samples failed to meet their guaranties, two being deficient in nitrogen, one in phosphoric acid, and three in both of these elements. **9365** and **9100** contained only about half of the phosphoric acid guaranteed.

The average cost was $53.44 per ton, about $2 higher than last year. If the phosphoric acid were valued at 4 cents per pound, the nitrogen cost on the average 28.8 cents per pound; if at 6 cents per pound, the nitrogen cost 27.2 cents.

ANALYSES OF

Station No.	Manufacturer	Dealer or Purchaser
	Sampled by Station:	
8921	Amer. Agr. Chem. Co.	C. O. Treat, Manchester
9045	Amer. Agr. Chem. Co.	C. K. Hale, Chicopee
9323	Amer. Agr. Chem. Co.	Spencer Bros., Suffield
9365	Apothecaries Hall Co.	Factory
9325	Berkshire Fert. Co.	Factory
9374	E. D. Chittenden Co.	F. T. Phelps, Suffield
9357	International Agr. Corp	S. B. Smith, East Haven
8924	Olds and Whipple	J. Gamble, Thompsonville
9354	Olds and Whipple	Factory
8925	F. S. Royster Guano Co.	S. J. Orr, West Suffield
	Sampled by Purchaser:	
9100*	L. T. Frisbie Co.	John Leonard, Burnside
8873	Olds and Whipple	K. C. Kulle, Suffield

TANKAGE.

(*Analyses on pages 386 and 387.*)

This material, made from the waste of slaughter houses and meat markets, naturally shows considerable differences in composition, depending upon the relative amounts of meat and bone present.

The thirteen samples analyzed fall into two quite well-defined groups, the one containing from 4.26 to 5.67 per cent. of nitrogen and from 14.06 to 21.42 per cent. of phosphoric acid, the other containing from 7.16 to 8.34 per cent. of nitrogen and from 5.62 to 11.19 per cent. of phosphoric acid.

The samples of the first group, approximately 6-30 grade, cost from $28 to $42 per ton; the higher grade tankages, 9-20, cost from $48 to $55 per ton.

The average composition and cost of the two grades were as follows:

Grade.	Nitrogen.	Phosphoric Acid.	Cost per Ton.
6–30	4.78	17.39	$35.33
9–20	7.83	7.96	51.00

Only four of these samples could be called fine, having 50 per cent. or more by weight in particles smaller than 1-50 inch.

Two samples failed to meet their nitrogen guaranty, one that for phosphoric acid, and one was deficient in both nitrogen and phosphoric acid.

FISH MANURES.

Nitrogen				Phosphoric Acid.			Total Phosphoric Acid.		
As Ammonia	As Organic	Total found.	Total guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Cost per ton.
0.20	7.77	7.97	8.23	0.85	5.03	0.36	6.24	6.0	$55.00
0.22	7.90	8.12	8.23	0.37	7.10	2.94	10.41	6.0	.....
0.19	7.81	8.00	8.23	0.65	4.01	0.75	5.41	6.0	55.00
0.14	7.62	7.76	8.20	0.25	2.24	0.26	2.75	5.5	48.00
0.24	8.23	8.47	8.23	0.40	5.04	1.74	7.18	6.0	57.00
2.23	5.05	7.28	8.00	0.18	4.02	0.83	5.03	6.0	52.00
0.23	8.01	8.24	8.20	0.32	4.87	2.09	7.28	....	.....
0.13	9.41	9.54	8.23	0.38	5.81	1.68	7.87	5.5	55.00
0.25	8.69	8.94	8.23	0.80	5.53	1.51	7.84	5.5	55.00
0.11	8.15	8.26	8.23	0.50	4.61	1.41	6.52	5.0	.....
....	....	7.71	7.41	....	....	....	6.95	14.0	50.00
....	....	9.75	8.23	....	....	....	7.82	5.5	54.00

ANALYSES OF

Station No.	Manufacturer.	Dealer or Purchaser.
8922	Amer. Agr. Chem. Co.	Spencer Bros., Suffield
9366	Apothecaries Hall Co.	Factory
9461	Atlantic Packing Co.	Frank S. Platt Co., New Haven
9334	Coe-Mortimer Co. (6–30)	Willis Smith, Winsted
9335	Conn. Fat Rend. and Fert. Corp.	Factory
9336	L. T. Frisbie Co.	Factory
8923	L. T. Frisbie Co.	Knowles, Lombard Co., Guilford
9358	Lister's Agr. Chem. Works (Celebrated Ground Bone and Tankage)	S. J. Orr, West Suffield
9359	E. Manchester & Sons	H. H. McKnight, Ellington
9362	Sanderson Fert. & Chem. Co.	W. H. Burr, Westport
9363	Sanderson Fert. & Chem. Co.	Factory
8926	Wilcox Fertilizer Co.	Factory
8948	....	S. D. Woodruff Sons, Orange

BONE MANURES.

(*Analyies on pages 388 and 389.*)

The analyses of twenty-one samples of bone are given in the table. "Bone," like tankage, has a wide range of composition, some samples being from raw bone with or without much adhering meat and cartilage, others representing bone which has been cooked, the grease and nitrogenous matter being partially removed.

The average per cent. of nitrogen in these samples is 3.40 and of phosphoric acid 23.35. The average cost per ton, barring the exceptional prices of **9393** and **9387**, was $40.60.

Two samples failed to meet their nitrogen and two their phosphoric acid guaranties.

V. MIXED FERTILIZERS.

NITROGENOUS SUPERPHOSPHATES.

REGARDING GUARANTIES.

The following tables, pages 394 to 415, present 375 analyses.

Of those sampled by the Station Agent 143 are guaranteed to contain potash. 172 contain no potash. Three brands were

TANKAGE.

Nitrogen.				Phosphoric Acid.		Mechanical Analysis.		
As Ammonia.	As Organic.	Total found.	Total guaranteed.	Found.	Guaranteed.	Finer than 1-50 inch.	Coarser than 1-50 inch.	Cost per ton.
0.39	5.28	5.67	4.94	14.06	13.73	40	60	$38.00
0.13	5.52	5.65	4.94	16.76	13.73	38	62	36.00
0.17	6.99	7.16	7.41	7.18	9.15	50	50	50.00
0.46	5.19	5.65	4.94	14.78	13.73	44	56	.....
0.20	4.06	4.26	3.00	21.42	20.00	59	41	28.00
0.22	4.46	4.68	4.92	15.62	15.00	18	82	42.00
0.22	7.35	7.57	7.38	11.19	10.00	24	76	48.00
0.14	2.56	2.70	2.67	13.85	12.00	56	44	.....
0.41	4.56	4.97	4.93	19.33	13.73	45	55	33.00
0.33	4.51	4.84	4.94	20.20	13.73	64	36	.....
0.29	4.34	4.63	4.94	20.46	13.73	62	38	35.00
0.24	7.99	8.23	8.24	5.62	8.00	28	72	55.00
0.28	8.06	8.34	....	5.86	.....	33	67	.....

guaranteed to contain four per cent. of potash, though only one had nearly that amount. Seven brands guaranteed 3 per cent., nineteen 2, and the rest 1 per cent. or less.

Of the brands containing potash about 23 per cent. failed to meet their guaranty in one ingredient, while of the 172 without potash 16.8 per cent. failed in the same way.

In a large number of cases, however, a shortage of one ingredient was made good by an overrun of another, so that the buyer received full value for his money, but in the following brands this was not the case. Reckoning nitrogen at 27 cents, available phosphoric acid at 6 and potash at 30 cents per pound, respectively, the deficiency in money value per ton was:

No.	Name of Brand	Deficiency in Ton Value
9213	Armour's Bidwell's 3–8–1	$1.88
9299	" 5–8–4 Fertilizer	4.65
9290	" 7–6–1 "	3.83
9240	Bowker's Complete	9.52
9293	Coe-Mortimer's Red Brand Excelsior	3.50
9405	National Fertilizer Co.'s Extra H. G. Potato	1.81
9039	Rogers & Hubbard Co.'s Bone Base Soluble Potato	1.68
9306	A. A. C. Co.'s H. G. Grass Top Dressing	1.80
9316	Atlantic Packing Co.'s Tobacco Special	1.17
9130	International Agr'l Corp's. Buffalo Top Dresser	3.15
9131	" " " Vegetable and Potato	1.99
9173	N. E. Fertilizer Co.'s Potato Fertilizer	1.26

ANALYSES OF

Station No.	Manufacturer and Brand.	Dealer or Purchaser.
	Sampled by Station:	
9376	Amer. Agr. Chem. Co., Fine Ground Bone..	L. F. Burr, Branford...........
9377	Apothecaries Hall Co., Bone.............	Factory.......................
9378	Armour Fertilizer Works, Bone Meal.......	Brower & Malone, Norwalk.....
9379	Berkshire Fertilizer Co., Fine Ground Bone.	Wheeler & Co., Bridgeport......
9380	Bowker Fertilizer Co., Fresh Ground Bone..	A. L. Burdick, Westbrook.......
9381	Coe-Mortimer Co., Fine Ground Bone......	J. E. Stoddard, Abington.......
9375	L. T. Frisbie Co., Fine Bone Meal.........	Lightbourn & Pond, New Haven
9414	L. T. Frisbie Co., Bone Meal.............	Frank S. Platt Co., New Haven.
9382	Lister's Agr. Chem. Works, Bone Meal.....	F. C. Benjamin, Danbury.......
9383	*Lowell Fertilizer Co., Ground Bone*.........	*Geo. S. Phelps & Co., Thompsonvill*
9385	Rogers & Hubbard Co., Hubbard's Pure Raw Knuckle Bone Flour...............	E. A. Buck, Willimantic.........
9384	Rogers & Hubbard Co., Hubbard's Strictly Pure Fine Bone........................	J. P. Barstow & Co., Norwich...
9393	Rogers & Hubbard Co., Rogers' Knuckle Bone Flour............................	Cadwell & Jones, Hartford .....
9392	*Rogers & Hubbard Co., Rogers' Pure Fine* Ground Bone..........................	Factory.......................
9386	F. S. Royster Guano Co., Fine Ground Bone Meal..............................	S. J. Orr, West Suffield.........
9387	Sanderson Fert. & Chem. Co., Fine Ground Bone..............................	W. H. Burr, Westport.... .....
9388	M. L. Shoemaker & Co., Swift-Sure Bone Meal..............................	Olds & Whipple, Hartford......
9389	Wilcox Fertilizer Co., Pure Ground Bone...	Factory....... ....
	Sampled by Purchaser:	
8829	Apothecaries Hall Co., Bone..............	H. B. Cornwall, Meriden........
9024	Bowker Fertilizer Co., High Grade Ground Bone..............................	James O'Connor, Wethersfield...
8775	L. T. Frisbie Co., Bone Meal..............	H. W. Ferry, So. Glastonbury....

* Car lot.

Quality of Plant Food in Nitrogenous Superphosphates.

The potash given in the analyses is all water-soluble and available to crops.

The same is true of the "soluble" phosphoric acid. The "citrate-soluble" phosphoric acid, which with the water-soluble is called "available" by trade usage, is doubtless more promptly available to crops than the insoluble, although there are probably

BONE MANURES.

Nitrogen.		Phosphoric Acid.		Mechanical Analysis.		
Found.	Guaranteed.	Found.	Guaranteed.	Finer than 1-50 inch.	Coarser than 1-50 inch.	Cost per ton.
3.15	2.47	21.38	22.88	41	59	$38.00
3.21	2.47	23.98	22.00	59	41	36.00
3.12	2.47	25.08	22.00	53	47	45.00
3.08	2.50	22.32	20.00	44	56	40.00
2.58	2.47	24.36	22.88	51	49	42.00
3.12	2.47	24.00	22.88	51	49	.....
3.17	2.46	25.10	20.00	45	55	44.00
4.09	3.93	20.58	21.39	35	65	44.00
3.64	2.47	23.20	23.00	57	43	40.00
2.47	2.46	26.18	20.00	69	31	37.00
3.94	3.82	25.08	24.70	39	61	.....
3.27	3.50	21.08	20.00	62	38	41.00
3.88	3.82	25.16	24.70	71	29	55.00
3.40	3.50	20.14	20.00	41	59	.....
2.61	2.47	23.48	22.90	50	50	40.00
2.23	2.47	21.64	20.00	65	35	*34.00
6.26	4.53	20 64	20.00	56	44	47.00
2.74	2.46	26.26	22.00	51	49	41.00
4.93	....	18.86	.....	80	20	.....
3.69	3.29	25.07	20.50	46	54	39.00
2.84	2.46	26.71	20.00	..	..	35.00

very considerable differences in the agricultural value of citrate-soluble phosphoric acid from different sources or materials. The same is true, also, of insoluble phosphoric acid. Thus, the insoluble phosphoric acid of bone is much more quickly available to crops than that from phosphate rock or apatite.

It is safest to give preference to those mixed fertilizers in which the proportion of insoluble phosphoric acid is small.

Regarding nitrogen, that which is in form of nitrates is the

BRANDS IN WHICH INFERIOR FORMS OF NITROGEN ARE INDICATED.

Station No.	Brand.	Organic Nitrogen.					
		Total.	Water-soluble.	Active-insoluble.	Inactive-insoluble.	Per cent. active insoluble by Alkaline Method.	Per cent. active insoluble by Neutral Method.
9117	Armour's Wheat, Corn and Oats Special...	0.81	0.25	0.27	0.29	48.0	74.4
8980	Armour's 1–8–2 Fertilizer..............	0.80	0.25	0.15	0.40	28.0	47.6
9282	Royster's Dreadnaught Fertilizer.........	0.78	0.33	0.19	0.26	42.2	74.4
8918	Royster's Logical Compound............	1.39	0.60	0.34	0.45	42.6	83.6
8972	Mapes' 5% Ammonia Special	0.59	0.09	0.22	0.28	44.4	76.2

most quickly and completely available. As a rule the nitrogen of ammonia salts is less quickly and completely available than that of nitrates, but ranks next to it.

The organic nitrogen of fertilizers is supplied by a great variety of materials which differ very considerably in agricultural value.

The details of the methods used to detect very inferior forms of nitrogen have been given in previous reports.

By the alkaline permanganate method forms of organic nitrogen are considered inferior in which less than 50 per cent. of the water-insoluble, organic nitrogen is soluble in the reagent. By the neutral permanganate method, any solubility of less than 80 per cent. is suspicious. Some objection has been made to the method because dried horse and sheep manure, recognized as good fertilizers are ranked as inferior by these methods. It is true that both have agricultural value, but this depends to a considerable extent on the favorable action in the soil of the decomposing vegetable matter, while experiment has shown that the organic nitrogen in them is less available than in the forms ordinarily used in the compounding of fertilizers.

In the following brands inferior forms of nitrogen are indicated by both methods:

Regarding Prices of Nitrogenous Superphosphates.

The dealers' quotation of the cash ton price was obtained in most cases when each sample was drawn. These prices are, however, no real guide to prospective purchasers. The manufacturer has little or no control over the price which the retailer or agent will charge and the latter sells to the consumer according to special terms made with him, which are largely governed by time of payment and knowledge of the consumer's financial standing and habits. To take a concrete case: To-day a 2-10-0 formula can be bought for $40. That is called the "cash ton price."

But if paid for before Feb. 1 its price will be $37; if before Apr. 1, $37.40; July 1, $38.00 and on Dec. 1, $40. If bought in car lots it will cost $1.00 per ton less. If sold in small fractions of a ton the price will be considerably higher. Again, if several dealers in one place are competing for trade, the quoted prices are likely to be less than where there is no competition, or where the dealer knows that payments will be slow.

The general range of prices is shown in the following table:

AVERAGE HIGHEST AND LOWEST PRICES QUOTED TO THE STATION AGENT, 1917.

Formula.	Average Cash Ton Price.	Lowest.	Highest.
1- 7-1	$29.00	.....	.....
1- 8-1	29.75	$28.00	$31.00
1-10-1	31.67	30.00	35.00
2- 8-1	33.50	30.00	34.00
2 -9-1	33.33	31.00	36.00
2-10-1	35.10	32.00	38.00
2- 8-3	42.50	.....	.....
2- 8-4	50.00	.....	.....
3- 6-½	37.50	.....	.....
3- 8-½	27.75	25.50	32.00
3- 8-1	36.00	34.00	39.00
3- 9-1	36.23	34.00	41.00
4- 6-2	33.50	.....	.....
4- 8-1	36.75	33.00	40.00
4- 8-4	54.00	.....	.....
4- 9-1	38.19	33.00	44.00
4-10-3	49.50	48.00	51.00
5- 3-1	38.50	.....	.....
5- 4-1	41.50	40.00	42.00
5- 6-1	42.00	.....	.....
5- 4-2	45.75	.....	.....
5- 8-1	43.36	39.00	50.00
5- 8-4	65.00	.....	.....
6- 4-2	52.00	.....	.....
7- 6-1	49.00	.....	.....
10- 5-1	59.00	.....	.....
12- 5-1	66.00	.....	.....

A rough "valuation" may be made by valuing nitrogen as

Nitrates at........................	26 cents
Ammonia at........................	29 "
Organic........................	25 "
Available phosphoric acid at..........	6½ cents
Water-soluble potash................	28½ "

ANALYSES REQUIRING SPECIAL NOTICE.

8910. The American Ag'l. Chem. Co.'s Complete Manure for Top Dressing 1916 was found below guaranty in nitrogen. A second sample, **9345,** taken from a different source, was analyzed with approximately the same results.

8909. The above company's Sure Growth Phosphate being somewhat below guaranty in potash, a second sample, **9344,** of this brand from a different source was found to meet fully its guaranty.

A similar result appears in the two analyses of Bradley's Patent Superphosphate, 1916, Nos. **8977** and **9346.**

9213. Armour Fertilizer Co.'s Bidwell's 3-8-1, having considerably less nitrogen than was guaranteed, the manufacturer requested the analysis of another sample, but it was not possible at that time to find the brand on sale in the State.

9032. Coe-Mortimer Co.'s New Englander Special 1916, being found deficient in both nitrogen and potash, effort was made without success to find for analysis another sample.

9405. National Extra High Grade Potato Fertilizer showed deficiencies in all three ingredients and we were unable to get another sample from a different source for analysis.

9040. The Royster Guano Co.'s Dreadnaught Fertilizer, having been found deficient in potash, a second sample, **9282,** was drawn from a different source, which showed more potash, 1.86 per cent., the guaranty being 2 per cent.

9068. Quinnipiac Wrapper Leaf Brand Tobacco Manure, without Potash, not meeting its nitrogen guaranty, a second sample was analyzed, **9319,** which fully met the guaranty.

8997. Rogers H. G. Soluble Tobacco Manure failing to meet its guaranty of available phosphoric acid, a second sample, **9347,** drawn from a different source, was analyzed but agreed in composition with the first sample. It will be noticed that most of the superphosphates without potash made by this firm, while fully meeting their guaranties in all other respects, fail to meet them in the one particular of "available" phosphoric acid. The manufacturer states that the phosphatic material used is precipitated bone mixed with fine bone sawings; that the amount of available phosphoric acid found in these materials when separately analyzed should yield fully the amount guaranteed in the mixture of them; but that this is not the case and that there are large discrepancies between the analyses of mixtures of these two ingredients reported by different trade chemists. Examination of the bone used shows the presence of a considerable amount of carbonate of lime. The presence of carbonates, we believe, in any fertilizer is likely to reduce the amount of "available" phosphoric acid found by the official method. The precipitated bone, whether alone or mixed with carbonates, is, we believe, readily available to crops.

9225. Royster's Curfew Ammoniated Superphosphate having failed to meet its nitrogen guaranty, a second sample, **9348,** drawn from a different source, was analyzed and substantially met the nitrogen guaranty. The same thing was found in Royster's Good Will Ammoniated Superphosphate, Samples **9228** and **9404.**

8907. In Sanderson's H. G. Ammoniated Phosphate the available phosphoric acid was below guaranty but in two other samples of the same brand, **9075** and **9308,** this guaranty was fully met.

TABLE I—NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling	Dealer's cash price per ton.
	Sampled by Station:		
	American Agricultural Chemical Co., New York City.		
*8910	Complete Manure for Top Dressing 1916	Milford	$43.75
*9345	Complete Manure for Top Dressing 1916	Hazardville	43.75
*8909	Sure Growth Phosphate 1916	Hazardville	36.75
*9344	Sure Growth Phosphate 1916	Thompsonville	36.00
9212	Triumph Crop Special	Milford	.....
9291	Bradley's B. D. Sea Fowl Guano 1916	Middletown	35.00
8978	Bradley's Complete Manure for Potatoes and Vegetables 1916	Norwalk	37.50
9181	Bradley's Corn Phosphate 1916	South Coventry	.....
9182	Bradley's Half Century Fertilizer 1916	Canaan	35.00
9305	Bradley's New Method Fertilizer 1916	Canaan	31.00
*8977	Bradley's Patent Superphosphate 1916	Suffield	34.00
*9346	Bradley's Patent Superphosphate 1916	Thompsonville	34.00
8976	Bradley's Potato Fertilizer 1916	Groton	35.00
9183	Bradley's Potato Manure 1916	Suffield	36.00
8979	Bradley's Tobacco Manure 1916	Glastonbury	40.25
9047	Bradley's Tobacco Manure (Carb.)	Hartford	.....
9294	Bradley's Unicorn 1916	Cos Cob	33.00
9185	East India Corn King 1916	Southport	34.00
9187	East India Potato and Garden Manure	Burnside	37.00
9184	East India Roanoke Phosphate 1916	Southport	31.00
9288	East India Tobacco Special 1916	Burnside	39.00
9186	East India Unexcelled Fertilizer 1916	Southport	33.00
9189	Quinnipiac Ammoniated Dissolved Bone 1916	Branford	31.00
9236	Quinnipiac B Fertilizer 1916	Shelton	35.00
9188	Quinnipiac Climax Phosphate 1916	Milford	30.00
9320	Quinnipiac Climax Phosphate 1916	East Haven	.....
9190	Quinnipiac Fish and Potash Mixture 1916	Windsor	34.00
9191	Quinnipiac Market Garden Manure 1916	Hazardville	37.50
8911	Quinnipiac Potato Phosphate 1916	Branford	32.00
9192	Quinnipiac Wrapper Leaf Brand Tobacco Manure	Hazardville	41.00
9295	Wheeler's Corn Fertilizer 1916	New Milford	32.00
9296	Wheeler's Cuban Tobacco Grower 1916	New Milford	44.00
9297	Wheeler's Potato Manure 1916	New Milford	34.00
9207	Williams and Clark's Americus Corn Phosphate 1916	Milford	.....
9298	Williams and Clark's Americus H. G. Special for Potatoes and Root Crops, 1916	Southington	39.00
9208	Williams and Clark's Americus Potato Manure	Waterbury	35.00
9237	Williams and Clark's Elk Brand 1916	Waterbury	30.00
9209	Williams and Clark's Meadow Queen Fertilizer 1916	Milford	.....
9210	Williams and Clark's Seed Leaf Tobacco Manure 1916	Manchester	.....
9304	Williams and Clark's Special Prolific Crop Producer	Norfolk	30.00
	Apothecaries Hall Co., Waterbury, Conn.		
9286	Victor Tobacco Special	Wapping	42.00

* See page 392.

WITH POTASH.

Nitrogen.						Phosphoric Acid.							
				Total					Total.		So-called "Available"		
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, water-insoluble	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble	Found.	Guaranteed.	Found.	Guaranteed.	As M
0.94	0.98	0.20	1.68	3.80	4.11	6.26	3.52	0.67	10.45	9.0	9.78	8.0	1.
1.03	0.99	0.16	1.66	3.84	4.11	5.75	3.48	0.51	9.74	9.0	9.23	8.0	0.
0.60	0.84	0.42	0.84	2.70	2.47	6.01	4.02	1.19	11.22	10.0	10.03	9.0	0.
0.38	1.07	0.24	1.15	2.84	2.47	6.08	3.91	1.04	11.03	10.0	9.99	9.0	0.
1.18	0.04	0.48	0.79	2.49	2.47	4.96	3.32	1.37	9.65	9.0	8.28	8.0	2.
0.24	0.12	0.09	0.49	0.94	0.82	5.83	4.51	1.20	11.54	11.0	10.34	10.0	0.
1.82	0.05	0.73	0.86	3.46	3.29	5.52	3.96	1.97	11.45	10.0	9.48	9.0	1.
0.46	0.50	0.32	0.49	1.77	1.65	5.83	4.76	1.13	11.72	11.0	10.59	10.0	1.
0.41	0.44	0.49	0.60	1.94	2.06	5.26	5.39	1.75	12.40	11.0	10.65	10.0	1.
0.07	0.08	0.56	0.22	0.93	0.82	6.51	2.46	1.09	10.06	9.0	8.97	8.0	0.
0.14	0.58	0.34	1.00	2.06	2.06	5.50	4.16	0.87	10.53	9.0	9.66	8.0	0.
0.26	0.33	0.27	1.22	2.08	2.06	5.10	4.49	0.90	10.49	9.0	9.59	8.0	0.
0.53	0.76	0.61	0.56	2.46	2.06	4.35	5.09	1.36	10.80	9.0	9.44	8.0	0.
0.63	0.56	0.29	1.07	2.55	2.47	6.11	4.60	0.79	11.50	10.0	10.71	9.0	1.
0.87	0.05	0.09	3.43	4.44	4.53	1.56	2.85	0.43	4.84	4.0	4.41	3.0	0.
0.60	0.11	1.12	2.89	4.72	4.53	0.33	3.16	0.28	3.77	4.0	3.49	3.0	0.
0.17	0.88	0.38	0.70	2.13	1.65	7.01	3.55	1.57	12.13	10.0	10.56	9.0	0.
0.60	0.55	0.44	0.77	2.36	2.47	6.46	4.17	0.97	11.60	10.00	10.63	9.00	1.
0.97	1.04	0.58	0.90	3.49	3.29	5.28	4.17	2.03	11.48	10.0	9.45	9.0	1.
0.21	0.20	0.21	0.96	1.58	1.23	6.88	4.12	1.68	12.68	11.0	11.00	10.0	1.
0.88	0.08	0.18	3.37	4.51	4.53	2.15	1.56	0.49	4.20	4.0	3.71	3.0	0.
0.21	0.50	0.25	0.84	1.80	2.06	5.70	4.02	1.27	10.99	9.0	9.72	8.0	0.
0.12	0.15	0.51	0.93	1.71	1.65	1.94	8.64	1.74	12.32	10.0	10.58	9.0	1.
0.38	0.12	0.42	0.45	1.37	1.23	6.10	4.64	1.75	12.49	11.0	10.74	10.0	0.
1.06	1.16	0.54	0.89	3.65	0.82	6.07	3.75	0.93	10.75	9.0	9.82	8.0	1.
0.23	0.17	0.64		1.04	0.82	4.20	4.78	0.97	9.95	9.0	8.98	8.0	0.
0.55	0.60	0.57	0.76	2.48	2.47	5.21	4.46	1.56	11.23	10.0	9.67	9.0	0.
1.05	1.10	0.48	0.78	3.41	3.29	5.85	3.94	0.96	10.75	10.0	9.79	9.0	1.
0.18	0.30	0.54	1.72	2.74	2.06	1.22	7.78	1.80	10.80	9.0	9.00	8.0	1.
1.18	0.06	0.08	3.10	4.42	4.53	2.46	1.55	0.63	4.64	4.0	4.01	3.0	0.
0.30	0.25	0.26	0.64	1.45	1.65	5.45	4.68	0.96	11.09	11.0	10.13	10.0	1.
1.22	0.04	0.26	3.08	4.60	4.53	2.46	1.48	0.50	4.44	4.0	3.94	3.0	0.
1.25	0.35	0.48	0.86	2.94	2.06	6.45	4.09	1.01	11.55	11.0	10.54	10.0	0.
0.54	0.22	0.57	0.58	1.91	1.65	5.58	4.91	1.73	12.22	11.0	10.49	10.0	1.
0.91	0.88	0.63	0.73	3.15	3.29	6.46	3.80	0.86	11.12	10.0	10.26	9.0	0.
0.34	0.24	0.24	1.14	1.96	2.06	4.69	4.53	0.95	10.17	9.0	9.22	8.0	0.
0.16	0.08	0.17	0.47	0.88	0.82	7.91	5.00	0.88	13.79	11.0	12.91	10.0	1.
0.89	0.43	0.47	0.77	2.56	2.47	5.00	4.79	1.65	11.44	10.0	9.79	9.0	0.
0.95	0.10	0.00	3.25	4.30	4.53	1.56	1.93	0.35	3.84	4.0	3.49	3.0	0.
0.43	0.05	0.19	0.65	1.32	0.82	5.73	3.39	1.59	10.71	9.0	9.12	8.0	0.
0.17	1.69	0.52	1.76	4.14	4.11	2.63	1.36	0.51	4.50	5.0	3.99	4.0	1.

§0.83% as sulphate, 1.29% as carbonate.

TABLE I.—NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	Armour Fertilizer Works, Chrome, N. J.		
9115	Grain Grower, 2–8–2 Fertilizer	Rockville	$35.00
9116	Special Tobacco Grower No. 1, 5–4–1 Fertilizer	Hazardville	42.00
‡9117	Wheat, Corn, Oats Special, 1–7–1 Fertilizer	Bridgeport	29.00
†*9213	Bidwells 3–8–1	Windsor Locks	34.00
‡8980	1–8–2 Fertilizer	Bridgeport	34.00
8981	2–8–3 Fertilizer	Hazardville	42.50
9214	2½–8–1	Thompsonville	35.00
9215	3–8–1	Norwalk	39.00
9114	4–8–1	Manchester	38.00
†9299	5–8–4 Fertilizer	Orange	65.00
†9290	7–6–1 Fertilizer	New London	48.00
	Bowker Fertilizer Co., New York City.		
8982	All Round Fertilizer 1916	Meriden	34.00
9241	Ammoniated Food for Flowers	Waterbury	*
†9240	Complete	Milldale	51.00
9239	Corn Phosphate 1916	West Stafford	38.00
8912	Farm and Garden Phosphate 1916	New Haven	36.00
8983	Stockbridge General Crop Manure 1916	Yalesville	44.00
9217	Hill and Drill Phosphate 1916	Yalesville	41.00
9242	Lawn and Garden Dressing 1916	New Haven	50.00
9238	Stockbridge Early Crop Manure 1916	West Stafford	43.00
9216	*Sure Crop Phosphate 1916*	Waterbury	....
	E. D. Chittenden Co., Bridgeport, Conn.		
9243	Complete Tobacco and Onion Grower, 2% Potash	Broad Brook	....
9244	Connecticut Tobacco Grower	Broad Brook	....
9302	Connecticut Tobacco Grower	Suffield	52.0
9245	Tobacco Special, 2% Potash	Suffield	50.0
	Coe-Mortimer Co., New York City.		
9246	Columbian Corn and Potato Fertilizer 1916	Milford	30.0
9247	Gold Brand Excelsior Guano 1916	Washington Depot	38.0
9292	H. G. Potato Fertilizer Revised	Greenwich	48.0
§9032	New Englander Special 1916	Brooklyn	28.0
†9293	Red Brand Excelsior Guano 1916	Greenwich	48.0
9254	*Standard Potato Fertilizer 1916*	Wethersfield	31.3
	T. H. Eldredge, Norwich, Conn.		
8913	Fish and Potash	Norwich	32.0
	International Agricultural Corporation, Buffalo, N. Y.		
92[illegible]8	Buffalo Economy	West Suffield	34.6
92[illegible]5	Buffalo General Favorite	East Granby	....

* See page 392. † See page 387. ‡ See page 390. § See page 393.

WITH POTASH—(*Continued*).

Nitrogen.						Phosphoric Acid.							Potash.			
				Total.					Total.		So-called "Available"					
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.	Station No.
.13	0.28	0.34	1.01	1.76	1.65	2.78	5.36	1.28	9.42	8.5	8.14	8.0	1.96	1.96	2.0	**9115**
.18	0.10	0.77	3.16	4.21	4.11	3.12	1.64	0.72	5.48	4.5	4.76	4.0	0.20	1.07	1.0	**9116**
.03	0.08	0.25	0.56	0.92	0.82	4.54	2.82	0.81	8.17	7.5	7.36	7.0	0.70	1.02	1.0	**9117**
.17	0.55	0.51	0.95	2.18	2.47	4.48	3.26	1.16	8.90	8.5	7.74	8.0	0.20	1.00	1.0	**9213**
.05	0.05	0.25	0.55	0.90	0.82	4.52	3.79	0.86	9.17	8.5	8.31	8.0	1.14	2.04	2.0	**8980**
.19	0.24	0.40	0.90	1.73	1.65	3.45	4.48	1.18	9.11	8.5	7.93	8.0	3.04	3.04	3.0	**8981**
.26	0.16	0.26	1.48	2.16	2.06	4.46	3.52	1.32	9.30	8.5	7.98	8.0	1.00	1.00	1.0	**9214**
.24	0.21	0.99	1.28	2.72	2.47	4.02	3.54	1.69	9.25	8.5	7.56	8.0	0.51	1.04	1.0	**9215**
.63	0.22	0.47	2.02	3.34	3.29	5.04	3.11	0.75	8.90	8.5	8.15	8.0	1.07	1.07	1.0	**9114**
.20	0.12	0.56	1.88	3.76	4.11	4.61	2.84	0.87	8.32	8.5	7.45	8.0	3.64	3.64	4.0	**9299**
.55	0.57	0.43	2.37	4.92	5.76	4.30	1.94	0.64	6.88	6.5	6.24	6.0	1.07	1.07	1.0	**9290**
.16	0.90	0.54	0.85	2.45	2.06	6.57	3.54	1.84	11.95	11.0	10.11	10.0	0.85	1.01	1.0	**8982**
.68	0.03	0.19		2.90	2.47	0.41	5.93	1.50	7.84	7.0	6.34	6.0	2.11	2.79	2.0	**9241**
.10	1.18	0.34	0.98	2.60	3.29	6.92	3.05	0.96	10.93	11.0	9.97	10.0	2.02	2.02	3.0	**9240**
.50	0.38	0.54	0.34	1.76	1.65	6.30	4.52	1.45	12.27	11.0	10.82	10.0	0.75	0.98	1.0	**9239**
...	0.48	0.38	1.08	1.94	1.65	6.56	4.09	0.95	11.60	11.0	10.65	10.0	1.17	1.17	1.0	**8912**
...	1.72	0.62	0.94	3.28	3.29	7.78	2.57	0.95	11.30	10.0	10.35	9.0	0.87	0.87	1.0	**8983**
.19	0.95	0.33	1.01	2.48	2.47	6.44	3.52	0.97	10.93	10.0	9.96	9.0	1.13	1.13	1.0	**9217**
.32	0.05	0.25	1.02	4.64	4.11	5.11	3.34	0.35	8.80	9.0	8.45	8.0	1.00	1.00	1.0	**9242**
.32	1.43	1.11	0.32	4.18	4.11	4.07	4.07	1.42	9.56	9.0	8.14	8.0	1.11	1.11	1.0	**9238**
.18	0.20	0.18	0.48	1.04	0.82	5.26	5.33	1.00	11.59	11.0	10.59	10.0	0.71	1.00	1.0	**9216**
.16	1.90	0.15	1.09	3.30	3.29	7.80	1.63	0.65	10.08	9.0	9.43	8.0	1.11	1.99	2.0	**9243**
.12	2.94	0.31	1.38	4.75	4.95	3.75	1.14	0.38	5.27	5.0	4.89	4.0	0.20	2.07	2.0	**9244**
.18	3.02	0.13	1.62	4.95	4.94	3.83	0.89	0.32	5.04	5.0	4.72	4.0	0.20	1.94	2.0	**9302**
.11	2.56	0.20	1.65	4.52	4.50	3.43	0.70	0.27	4.40	4.0	4.13	3.0	0.15	2.02	2.0	**9245**
.24	0.28	0.48	0.50	1.50	1.23	6.12	4.60	1.61	12.33	11.0	10.72	10.0	1.02	1.02	1.0	**9246**
.91	0.44	0.50	0.69	2.54	2.47	5.85	4.41	1.43	11.69	10.0	10.26	9.0	0.80	0.97	1.0	**9247**
.27	1.65	0.20	1.07	3.19	3.29	7.77	2.88	0.42	11.07	11.0	10.65	10.0	3.01	3.01	3.0	**9292**
.43	0.62	0.48	0.42	1.95	0.82	4.83	5.00	1.30	11.13	9.0	9.83	8.0	0.20	0.55	1.0	**9032**
.91	1.12	0.37	1.18	3.58	4.11	4.63	3.44	0.92	8.99	9.0	8.07	8.0	0.88	0.88	1.0	**9293**
.12	1.20	0.34	0.71	3.37	3.29	4.70	4.32	1.04	10.06	10.0	9.02	9.0	0.86	0.86	1.0	**9254**
.92	0.28	0.30	1.34	2.84	2.40	7.09	2.57	2.01	11.67	9.0	9.66	8.0	0.31	0.41	0.5	**8913**
.73	0.05	0.26	0.64	1.68	1.60	5.58	4.51	1.60	11.69	11.0	10.09	10.0	1.07	1.07	1.0	**9258**
.66	0.18	0.08	0.53	1.45	0.80	3.80	4.25	1.46	9.51	9.0	8.05	8.0	1.07	1.07	1.0	**9255**

TABLE I—NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	International Agricultural Corp., Buffalo, N. Y. (*Con.*)		
9257	Buffalo High Grade Manure	Stafford Springs	$33.00
9256	Buffalo Potash Special	West Cheshire	35.75
8984	Buffalo Potato and Corn	Waterbury	50.00
	Kirke Chemical Co., Brooklyn, N. Y.		
8985	Kirke Fertilizer	Greenwich	§
	Lister's Agricultural Chemical Works, Newark, N. J.		
9300	Ammoniated Dissolved Superphosphate 1916	Branford	32.00
9262	Complete Tobacco Manure 1916	West Suffield	40.00
8986	Corn and Potato Fertilizer 1916	West Suffield	31.00
9263	Potato Manure 1916	Burnside	42.00
9260	Special Tobacco Fertilizer 1916	Brookfield	33.00
9261	Standard Pure Superphosphate of Lime 1916	Burnside	35.00
9259	Success Fertilizer 1916	East Canaan	29.00
	Lowell Fertilizer Co., Boston, Mass.		
9264	Superior Fertilizer	Wethersfield	37.05
	E. Manchester and Sons, Winsted, Conn.		
9265	1917 Special	Ellington	39.00
	The Mapes Formula and Peruvian Guano Co., New York City.		
8987	Corn Manure 1916 Brand	Middletown	36.00
9033	General Special 1916 Brand	Windsor Locks	50.00
9034	Potato Manure 1916 Brand	Suffield	41.00
9403	Tobacco Manure 1916 Brand	Hartford	59.00
8914	Tobacco Starter Improved	Windsor Locks	42.00
9119	Top Dresser Half Strength 1916 Brand	Hartford	42.00
9118	Top Dresser Full Strength 1916 Brand	Hartford	66.00
	National Fertilizer Co., New York City.		
8915	Complete Root and Grain Fertilizer 1916	Thompsonville	39.50
9121	Eureka Potato Fertilizer 1916	So. Manchester	38.25
9037	Extra H. G. Manure 1916	Warehouse Point	41.75
†*9405	Extra H. G. Potato Fertilizer	West Cheshire	54.00
9036	Potato Phosphate 1916	Guilford	.....
8916	Tobacco Special 1916	Warehouse Point	39.48
9035	Universal Phosphate 1916	Wallingford	30.00
9120	XXX Fish and Potash 1916	Wallingford	30.00
	Olds and Whipple, Hartford, Conn.		
9038	Complete Corn, Potato and Onion Fertilizer	Silver Lane	33.50
9268	Complete Tobacco Fertilizer	Hartford	42.50

*See page 393. †See page 387. § 30 cts. per package.

WITH POTASH—(*Continued.*)

Nitrogen.						Phosphoric Acid.							Potash.			
				Total.					Total.		So-called "Available"					
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, water-insoluble.	*Found.*	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	*Found.*	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.	Station No.
.06	0.19	0.79	0.58	3.62	3.30	2.66	6.63	2.57	11.86	9.0	9.29	8.0	2.03	2.03	1.0	**9257**
.19	*0.05*	*0.28*	*0.50*	*1.02*	*0.80*	*3.24*	*5.32*	*1.71*	*10.27*	*9.0*	*8.56*	*8.0*	*1.90*	*1.90*	*3.0*	**9256**
.61	0.21	0.40	0.48	1.70	1.60	2.04	6.54	0.82	9.40	9.0	8.58	8.0	3.90	3.90	4.0	**8984**
.03	0.02	0.14	0.07	5.26	5.00	8.28	1.97	0.46	10.71	8.3	10.25	7.5	3.05	3.05	3.15	**8985**
.77	0.14	0.55	0.59	2.05	2.06	3.52	4.31	2.39	10.22	9.0	7.83	8.0	0.31	0.93	1.0	**9300**
.38	0.10	0.39	1.97	3.84	4.11	2.32	2.72	1.42	6.46	5.0	5.04	4.0	0.31	0.97	1.0	**9262**
.71	0.22	0.63	0.69	2.25	2.06	1.57	6.13	2.65	10.35	9.0	7.70	8.0	1.03	1.03	1.0	**8986**
.74	1.28	1.53	0.72	4.27	4.11	4.24	4.11	1.82	10.17	9.0	8.35	8.0	0.23	1.08	1.0	**9263**
.86	0.08	0.60	0.68	2.22	2.06	4.46	5.49	2.65	12.60	11.0	9.95	10.0	0.47	1.36	1.0	**9260**
.60	0.34	0.79	0.90	2.63	2.47	4.69	4.23	2.57	11.49	10.0	8.92	9.0	1.02	1.02	1.0	**9261**
.14	*0.25*	*0.33*	*0.67*	*1.39*	*1.23*	*5.26*	*6.06*	*0.86*	*12.18*	*11.0*	*11.32*	*10.0*	*0.87*	*0.87*	*1.0*	**9259**
.51	1.79	0.55	0.68	3.53	3.69	6.24	3.01	0.50	9.75	10.0	9.25	9.0	1.14	1.14	1.0	**9264**
.07	0.23	0.65	1.42	4.37	4.11	2.38	5.76	2.03	10.17	.....	8.14	8.0	0.68	0.93	1.0	**9265**
.92	0.01	0.13	0.62	2.68	2.47	3.17	4.63	2.93	10.73	10.0	7.80	8.0	0.51	1.34	1.0	**8987**
.54	0.02	0.07	1.13	5.76	5.76	2.07	4.74	2.81	9.62	8.0	6.81	6.0	0.60	1.20	1.0	**9033**
.52	0.06	0.04	0.40	4.02	3.71	5.31	3.61	1.37	10.29	8.0	8.92	8.0	0.45	0.92	1.0	**9034**
.69	*0.11*	*0.83*	*2.59*	*8.22*	*8.23*	*0.16*	*5.34*	*2.70*	*8.20*	*8.0*	*5.50*	*5.0*	*0.80*	*1.53*	*1.0*	**9403**
.10	0.02	0.21	1.25	4.58	4.12	2.21	4.50	2.64	9.35	8.0	6.71	6.0	0.33	0.96	1.0	**8914**
.76	0.05	0.00	0.20	5.01	4.94	0.63	2.15	1.45	4.23	4.0	2.78	2.5	0.51	1.31	0.5	**9119**
.20	0.04	0.19	0.59	10.02	9.88	0.94	5.23	1.97	8.14	8.0	6.17	5.0	1.31	2.00	1.0	**9118**
.05	1.05	0.52	1.02	3.64	3.29	5.73	4.09	0.87	10.69	10.0	9.82	9.0	1.00	1.00	1.0	**8915**
.45	0.66	0.56	0.94	2.61	2.47	6.11	4.15	0.88	11.14	10.0	10.26	9.0	0.86	0.99	1.0	**9121**
.26	1.39	0.84	0.61	4.10	4.11	5.53	3.65	0.95	10.13	9.0	9.18	8.0	0.97	0.97	1.0	**9037**
.08	1.02	0.37	1.51	3.98	4.11	5.78	3.98	0.74	10.50	11.0	9.76	10.0	2.62	2.62	4.0	**9405**
.16	0.61	0.27	0.87	1.91	2.06	4.67	4.56	1.16	10.39	9.0	9.23	8.0	1.02	1.02	1.0	**9036**
.12	0.08	0.27	3.12	4.59	4.53	1.46	2.53	0.40	4.39	4.0	3.99	3.0	0.20	1.21	1.0	**8916**
.26	0.18	0.21	0.39	1.04	0.82	6.11	5.31	0.91	12.33	11.0	11.42	10.0	0.71	0.93	1.0	**9035**
.46	*0.25*	0.38	*1.10*	*2.19*	*2.06*	*6.30*	4.50	*1.52*	*12.32*	*11.0*	*10.80*	*10.0*	*1.03*	*1.03*	*1.0*	**9120**
.18	0.07	0.55	1.85	3.65	3.30	0.31	6.54	1.07	7.92	6.0	6.85	6.0	1.13	2.09	2.0	**9038**
.04	0.10	0.23	3.39	4.76	4.50	1.19	2.33	0.37	3.89	3.0	3.52	3.0	0.11	1.49	1.0	**9268**

TABLE I—NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	Olds & Whipple, Hartford, Conn. (*Continued.*)		
9049	Complete Tobacco Fertilizer	Hartford	.....
9050	Complete Tobacco Fertilizer	Hartford	.....
9051	Complete Tobacco Fertilizer	Hartford	.....
9269	Fish and Potash	Ellington	$37.50
	Rogers and Hubbard Co., Portland, Conn.		
†9039	Hubbard's Bone Base Soluble Potato Manure	Branford	50.00
9271	Hubbard's Tobacco Special	Portland	.....
9272	Rogers' H. G. Soluble Tobacco and Potato Manure	Somers	47.00
9273	Rogers' H. G. Tobacco Grower (Vegetable Formula)	Granby	41.00
	F. S. Royster Guano Co., Baltimore, Md.		
9289	Arrow Head Tobacco Fertilizer	Hockanum	45.25
*9040	Dreadnaught Fertilizer	Madison	36.00
*‡9282	Dreadnaught Fertilizer	New Britain	42.00
9274	Drillwell Phosphate	Madison	35.00
‡8918	Logical Compound	West Suffield	.....
8917	Pipe of Peace Tobacco Fertilizer	Glastonbury	38.50
8919	Sensation Fertilizer	Plainville	40.00
9275	Trucker's Delight	Madison	54.00
9041	True Blue Compound	Windsor	.....
	Sanderson Fertilizer and Chemical Co., New Haven, Conn.		
9043	Atlantic Coast Bone, Fish and Potash 1916	Plainville	36.00
8908	Complete Tobacco Grower 1916	Glastonbury	41.00
9277	Corn Superphosphate 1916	East Hampton	33.00
9042	Formula A	Guilford	38.00
9276	Formula B	Bloomfield	.....
9283	Kelsey's Bone, Fish and Potash 1916	Branford	33.25
9278	Potato Manure	Stafford Springs	35.00
9301	Top Dressing for Grass and Grain 1916	East Hartford	.....
	Virginia-Carolina Chemical Co., New York City.		
9056	Indian Brand for Tobacco No. 1	Hazardville	.....
9057	Indian Brand for Tobacco No. 1	Southwick, Mass.	.....
9058	Indian Brand for Tobacco No. 1	Windsor Locks	.....
9059	Indian Brand for Tobacco No. 1	Weatogue	.....
9284	Indian Brand for Tobacco No. 2 (Sulph.)	Hazardville	42.00
9285	Owl Brand Potato and Truck Fertilizer with 1% Potash	Shelton	34.00
8920	XXXX Fish and Potash Mixture	Bristol	33.00
	Wilcox Fertilizer Co., Mystic, Conn.		
8887	Fish and Potash	Meriden	25.50
9124	H. G. Vegetable Fertilizer	Ellington	39.00

* See page 393. † See page 387. ‡ See page 390.

WITH POTASH—(*Continued*).

Nitrogen.						Phosphoric Acid.							Potash.			
				Total.					Total.		So-called "Available."					
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, water-*insoluble*.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.	*Station No.*
0.71	0.09	0.54	3.58	4.92	4.50	0.66	2.75	0.42	3.83	3.0	3.41	3.0	0.31	2.45	2.0	**9049**
0.49	0.06	0.96	3.42	4.93	4.50	0.81	2.75	0.43	3.99	3.0	3.56	3.0	0.31	2.31	2.0	**9050**
....	....	....	....	4.60	4.50	....	....	....	3.88	3.0	.....	3.0	0.31	2.36	2.0	**9051**
0.55	0.12	0.49	1.72	2.88	2.45	0.56	5.98	2.11	8.65	6.0	6.54	6.0	1.75	2.62	2.0	**9269**
1.63	0.95	0.82	0.96	4.36	4.25	0.11	8.27	4.72	13.10	12.0	8.38	10.0	0.20	0.93	1.0	**9039**
1.79	0.13	0.37	3.06	5.35	5.00	0.34	3.94	0.50	4.78	5.0	4.28	4.0	0.20	0.88	0.5	**9271**
1.64	1.19	0.54	0.94	4.31	4.25	0.09	8.27	4.94	13.30	12.0	8.36	10.0	0.20	1.02	1.0	**9272**
1.41	0.09	0.12	3.53	5.15	5.00	0.30	3.97	1.51	5.78	5.0	4.27	4.0	0.11	0.93	0.5	**9273**
0.24	0.71	0.19	2.80	3.94	4.11	2.15	2.02	0.82	4.99	4.5	4.17	4.0	0.20	1.96	2.0	**9289**
0.13	0.79	0.40	0.70	2.02	1.65	5.15	3.34	0.72	9.21	8.5	8.49	8.0	0.40	1.62	2.0	**9040**
0.69	0.27	0.33	0.45	1.74	1.65	5.47	2.62	1.20	9.29	8.5	8.09	8.0	0.25	1.86	2.0	**9282**
0.21	1.17	0.46	0.96	2.80	2.47	5.37	2.99	0.67	9.03	8.5	8.36	8.0	0.20	0.84	1.0	**9274**
....	0.55	0.60	0.79	1.94	1.65	5.45	2.69	0.65	8.79	8.5	8.14	8.0	0.20	0.97	1.0	**8918**
0.17	0.83	0.33	2.61	3.94	4.11	1.58	1.36	0.19	3.13	3.5	2.94	3.0	0.25	1.03	1.0	**8917**
0.48	0.72	0.58	1.63	3.41	3.29	6.22	2.25	0.70	9.17	8.5	8.47	8.0	0.40	1.07	1.0	**8919**
0.18	1.37	0.82	1.18	3.55	3.29	4.17	4.14	0.86	9.17	8.5	8.31	8.0	0.55	3.64	4.0	**9275**
0.12	1.28	0.71	1.27	3.38	3.29	4.97	4.10	0.60	9.67	8.5	9.07	8.0	0.60	2.71	3.0	**9041**
0.20	0.30	0.38	0.97	1.85	1.65	1.13	8.36	2.96	12.45	10.0	9.49	9.0	0.90	0.90	1.0	**9043**
1.00	0.14	0.06	3.31	4.51	4.53	0.61	3.03	0.49	4.13	4.0	3.64	3.0	0.31	1.04	1.0	**8908**
0.31	0.21	0.49	1.38	2.39	1.65	5.30	4.54	1.71	11.55	11.0	9.84	10.0	0.85	1.06	1.0	**9277**
0.50	0.61	0.71	1.49	3.31	3.29	6.76	3.73	3.13	13.62	10.0	10.49	9.0	0.90	1.13	1.0	**9042**
1.51	0.11	0.53	1.27	3.42	3.29	4.50	5.25	3.66	13.41	10.0	9.75	9.0	0.31	0.95	1.0	**9276**
0.93	0.06	0.56	1.16	2.71	2.47	4.89	5.67	0.79	11.35	10.0	10.56	9.0	0.20	0.87	1.0	**9283**
0.20	0.12	0.72	1.56	2.60	2.06	1.77	7.18	1.83	10.78	9.0	8.95	8.0	1.21	1.21	1.0	**9278**
2.20	0.06	0.54	1.45	4.25	4.11	3.69	4.85	1.50	10.04	9.0	8.54	8.0	1.66	1.66	1.0	**9301**
0.25	2.24	0.21	1.96	4.66	4.11	3.84	1.19	0.55	5.58	5.0	5.03	4.0	0.20	1.93	2.0	**9056**
....	....	....	....	4.48	4.11	....	....	....	5.54	5.0	.....	4.0	0.20	1.98	2.0	**9057**
....	....	....	....	4.48	4.11	....	....	....	5.80	5.0	.....	4.0	0.20	1.96	2.0	**9058**
....	....	....	....	4.39	4.11	....	....	....	6.14	5.0	.....	4.0	0.20	1.95	2.0	**9059**
0.19	1.87	0.50	2.02	4.58	4.11	3.25	1.60	0.70	5.55	5.0	4.85	4.0	1.00	1.00	1.0	**9284**
0.14	0.68	0.16	0.77	1.75	1.65	5.94	2.62	1.27	9.83	9.0	8.56	8.0	1.05	1.05	1.0	**9286**
....	0.68	0.41	0.81	1.90	1.65	6.55	2.71	1.50	10.76	9.0	9.26	8.0	0.94	0.94	1.0	**8926**
0.66	0.26	1.96		2.88	2.40	6.73	2.44	1.89	11.06	9.0	9.17	8.0	0.31	0.39	0.5	**8887**
0.94	0.08	1.44	1.62	4.08	4.12	6.12	2.81	0.54	9.47	9.0	8.93	8.0	0.76	0.76	1.0	**9124**

TABLE I.—NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	Wilcox Fertilizer Co., Mystic, Conn. (*Continued.*)		
9303	Potato Fertilizer	Suffield	$33.00
9122	Potato, Onion and Vegetable Phosphate	Guilford	36.00
9123	Tobacco Special	Ellington	40.00
	S. D. Woodruff & Sons, Orange, Conn.		
9125	Home Mixture	Orange	36.00
	Sampled by Purchasers and Others:		
8703	Quinnipiac Wrapper Leaf Brand	*Hartford;*—L. B. Haas and Co.	37.50
8704	Quinnipiac Wrapper Leaf Brand	*Hartford;*—L. B. Haas and Co.	37.50
8705	Quinnipiac Wrapper Leaf Brand	*Hartford;*—L. B. Haas and Co.	37.50
8833	Rogers' H. G. Tobacco Grower Vegetable Formula	*West Suffield;*—H. C. Nelson	.....
8834	Rogers' H. G. Tobacco Grower Vegetable Formula	*West Suffield:*—H. C. Nelson	.....
8961	Sanderson's Fish, Bone and Potash	*West Cheshire:*—Whitcomb & Hadley	29.75
9396	Sanderson's Kelsey's Bone, Fish and Potash	*Branford:*—A. E. Plant Sons' Co.	.....
8812	Unknown brand	*Brookfield Center:*—E. A. Talmadge	.....
9399	Unknown brand	*S. Windsor:*—W. N. Jennings	.....

WITH POTASH—(*Concluded.*)

Nitrogen.						Phosphoric Acid.							Potash.			
				Total.					Total.		So-called "Available."					
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, water-insoluble.	*Found.*	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.	Station No.
14	0.22	0.28	1.30	2.94	2.46	6.04	2.70	3.59	12.33	7.0	8.74	6.0	0.31	0.41	0.5	9303
01	0.10	0.48	1.43	4.02	3.72	4.62	3.89	2.01	10.52	9.0	8.51	8.0	0.40	0.63	0.5	9122
29	0.07	0.05	3.78	5.19	4.95	0.36	5.17	0.51	6.04	6.0	5.53	5.0	0.15	1.10	0.5	9123
76	0.10	1.27	1.50	3.63	3.30	5.45	2.99	0.78	9.22	....	8.44	8.0	0.62	0.62	1.0	9125
..	....	....	....	4.60	4.53	....	....	....	4.09	4.0	....	3.0	....	0.97	1.0	8730
..	....	....	....	4.59	4.53	....	....	....	4.20	4.0	....	3.0	....	0.97	1.0	8704
..	....	....	....	4.55	4.53	....	....	....	4.41	4.0	....	3.0	....	0.92	1.0	8705
..	....	....	....	5.14	5.00	....	....	....	5.31	5.0	....	4.0	0.23	1.07	0.5	8833
..	....	....	....	5.21	5.00	....	....	....	5.31	5.0	....	4.0	0.23	1.06	0.5	8834
..	....	....	....	2.10	....	....	....	....	12.26	....	....	....	0.89	0.89	....	8961
..	....	....	....	2.58	2.47	....	....	....	11.60	10.0	....	9.0	....	1.03	1.00	9396
..	....	....	....	3.52	....	....	....	....	8.12	....	....	....	....	5.14	....	8812
..	....	....	....	3.90	....	3.48	3.92	1.61	9.01	....	7.40	....	0.39	0.39	....	9398

TABLE II—NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station Agent:		
	American Agricultural Chemical Co., New York City.		
8964	Ammoniated Fertilizer A	Plantsville	$25.00
9000	Ammoniated Fertilizer AA	East Hampton	29.00
8965	Ammoniated Fertilizer AAA	East Hampton	32.00
8966	Ammoniated Fertilizer AAAA	Milford	35.75
9307	Cereal and Root Fertilizer	Rockville	.....
†9306	High Grade Grass Top Dressing without Potash	Rockville	.....
9001	Odorless Grass and Lawn Top Dressing without Potash	Stafford Springs	42.00
9006	Special Vegetable Fertilizer	New London	40.00
9002	Bradley's General Fertilizer	Putnam	30.00
9064	Bradley's Grain Fertilizer	Norwich	23.00
9067	Bradley's Grass Top Dressing without Potash	Norwich	42.00
9003	Bradley's Root Crop Manure	Black Hall	35.00
8927	Bradley's Special Corn Phosphate without Potash	Norwich	28.00
9076	Bradley's Special Potato Phosphate without Potash	Groton	30.00
8928	*Bradley's Special Potato Manure without Potash*	*Black Hall*	34.00
9066	Bradley's Tobacco Manure without Potash	Hazardville	39.50
9065	Bradley's Universal Crop Phosphate	Ellington	.....
9126	East India Tobacco Special without Potash	Burnside	35.50
9004	Quinnipiac Special Corn Manure without Potash	New London	31.00
9005	Quinnipiac Special Potato Phosphate without Potash	Plainfield	28.00
*9068	Quinnipiac Wrapper Leaf Brand Tobacco Manure without Potash	Windsor	35.75
*9319	Quinnipiac Wrapper Leaf Brand Tobacco Manure without Potash	Windsor	35.75
9078	Williams and Clark's Seed Leaf Tobacco Manure without Potash	South Manchester	36.00
9069	Williams and Clark's Special Americus Corn Phosphate without Potash	Ellington	29.00
9077	Williams and Clark's Special Americus Potato Manure without Potash	Ellington	29.00
	Apothecaries Hall Co., Waterbury, Conn.		
9070	Victor Corn, Fruit and All Crops	Windsorville	32.00
9079	Victor Market Gardeners Special	Windsorville	40.00
9071	Victor Potato and Vegetable Special	Windsorville	36.00
8988	Victor Tobacco Special (C. S. M.)	Waterbury	38.00
9080	Victor Top Dresser for Grass and Grain	Windsorville	46.00
	Armour's Fertilizer Works, Chrome, N. J.		
9169	3–10–0	Hazardville	32.25
8899	4–8–0	Hazardville	35.00
9315	5–10–0	New Canaan	40.00
9090	Special Tobacco Grower No. 2	Manchester	38.00
	Atlantic Packing Co., New Haven, Conn.		
9088	Atlantic Corn and Grain Fertilizer	New Haven	28.00
9089	Atlantic Potato Phosphate	New Haven	32.00
8898	Atlantic Special Vegetable	Groton	38.00
†9316	Atlantic Tobacco Special	South Windsor	37.00
8897	*Atlantic Top Dresser for Grass and Market Garden.*	*Groton*	40.00

WITHOUT POTASH.

Nitrogen.						Phosphoric Acid.								
				Total.					Total.		So-called "Available."		
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, water-insoluble	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble	Found.	Guaranteed.	Found.	Guaranteed.	*Station No.*
0.16	0.14	0.33	0.49	1.12	0.82	6.16	4.49	1.29	11.94	11.0	10.65	10.0	**8964**
0.12	0.25	0.90	0.71	1.98	1.65	5.55	4.46	1.96	11.97	11.0	10.01	10.0	**9000**
0.85	0.50	0.69	0.67	2.71	2.47	5.65	4.33	1.88	11.86	11.0	9.98	10.0	**8965**
0.90	1.36	0.57	0.61	3.44	3.29	6.84	3.79	1.23	11.86	11.0	10.63	10.0	**8966**
0.59	1.02	0.47	0.61	2.69	2.47	7.09	3.85	2.07	13.01	11.0	10.94	10.0	**9307**
3.15	1.62	0.52	0.79	6.08	6.58	5.92	2.83	0.92	9.67	9.0	8.75	8.0	**9306**
2.24	1.71	0.36	0.59	4.90	4.11	7.65	2.87	0.87	11.39	11.0	10.52	10.0	**9001**
1.27	1.13	0.51	0.60	3.51	3.29	6.00	3.99	1.75	11.74	11.0	9.99	10.0	**9006**
0.52	0.46	0.48	0.38	1.84	1.65	5.71	4.00	1.87	11.58	11.0	9.71	10.0	**9002**
0.44	0.35	0.10	0.23	1.12	0.82	5.64	4.73	0.56	10.93	11.0	10.37	10.0	**9064**
2.61	1.45	0.38	0.58	5.02	4.94	5.46	3.34	0.73	9.53	9.0	8.80	8.0	**9067**
1.14	0.08	1.65	0.51	3.38	3.29	6.36	3.71	1.79	11.86	11.0	10.07	10.0	**9003**
0.62	0.52	0.26	0.35	1.75	1.65	6.00	4.39	0.97	11.36	11.0	10.39	10.0	**8927**
0.63	0.50	0.31	0.36	1.80	1.65	6.42	4.69	0.88	11.99	11.0	11.11	10.0	**9076**
1.00	0.82	0.41	0.55	2.78	2.47	6.20	4.10	1.60	11.90	11.0	10.30	10.0	**8928**
1.06	0.10	0.37	3.13	4.66	4.53	1.20	2.61	0.37	4.18	4.0	3.81	3.0	**9066**
1.00	0.81	0.36	0.49	2.66	2.47	6.36	3.98	1.24	11.58	11.0	10.34	10.0	**9065**
0.26	0.06	0.98	3.27	4.57	4.53	1.58	2.15	0.52	4.25	4.0	3.73	3.0	**9126**
0.38	0.47	0.72	0.09	1.66	1.65	6.13	4.20	1.04	11.37	11.0	10.33	10.0	**9004**
0.60	0.57	0.30	0.55	2.02	1.65	6.38	3.77	1.65	11.80	11.0	10.15	10.0	**9005**
0.82	0.08	0.22	3.27	4.39	4.53	2.39	1.53	0.46	4.38	4.0	3.92	3.0	**9068**
0.87	0.10	3.58		4.55	4.53	2.17	1.58	0.47	4.22	4.0	3.75	3.0	**9319**
0.85	0.10	0.27	3.12	4.34	4.53	1.62	2.37	0.33	4.32	4.0	3.99	3.0	**9078**
0.73	0.41	0.37	0.34	1.85	1.65	6.14	4.26	1.33	11.73	11.0	10.40	10.0	**9069**
0.68	0.40	0.38	0.35	1.81	1.65	6.58	4.37	1.28	12.23	11.0	10.95	10.0	**9077**
0.38	0.18	0.46	0.83	1.85	1.65	8.30	2.74	2.20	13.24	11.0	11.04	10.0	**9070**
0.10	1.71	0.51	1.22	3.54	3.29	8.03	2.29	0.87	11.19	11.0	10.32	10.0	**9079**
0.98	0.48	0.51	0.60	2.57	2.47	8.34	2.28	2.16	12.78	11.0	10.62	10.0	**9071**
.....	1.70	0.60	2.00	4.30	4.11	3.06	1.78	0.70	5.54	5.0	4.84	4.0	**8988**
1.55	1.95	0.48	1.69	5.67	5.75	3.67	2.55	0.87	7.09	6.0	6.22	5.0	**9080**
0.13	0.43	0.31	1.71	2.58	2.47	7.29	2.79	1.27	11.35	10.5	10.08	10.0	**9169**
.....	1.31	0.58	1.27	3.16	3.29	6.07	2.00	1.27	9.34	8.5	8.07	8.0	**8899**
2.20	0.04	0.22	1.63	4.09	4.11	7.46	2.89	0.60	10.95	10.5	10.35	10.0	**9315**
0.97	0.11	0.06	3.12	4.26	4.11	2.79	1.61	0.81	5.21	4.5	4.40	4.0	**9090**
0.08	0.07	0.76	0.87	1.78	1.64	6.87	3.62	0.87	11.36	11.0	10.49	10.0	**9088**
0.24	0.74	0.72	0.86	2.56	2.46	7.28	3.24	0.47	10.99	11.0	10.52	10.0	**9089**
0.39	1.35	0.78	0.94	3.46	3.28	7.54	3.52	0.77	11.83	11.0	11.06	10.0	**8898**
0.84	0.08	1.03	1.76	3.71	4.10	2.98	3.80	1.69	8.47	7.0	6.78	6.0	**9316**
0.88	1.40	0.76	1.26	4.30	4.10	7.09	3.20	0.84	11.13	11.0	10.29	10.0	**8897**

TABLE II—NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station Agent:		
	Berkshire Fertilizer Co., Bridgeport, Conn.		
8900	Ammoniated Bone Phosphate	Norwich Town	$24.00
9081	Economical Grass Fertilizer	Rockville	50.00
9008	Grass Special	Centerbrook	42.00
9091	Market Garden Fertilizer	Westport	48.00
9007	Potato and Vegetable Phosphate	Westport	38.00
8929	Root Fertilizer	Waterbury	36.00
9082	Tobacco Grower	Rockville	36.00
	F. E. Boardman, Middletown, Conn.		
9092	Fertilizer for Potatoes and General Crops	Middletown	34.00
9093	Tobacco Fertilizer	Middletown	35.00
	Bowker Fertilizer Co., New York City.		
9127	Four Ten Hill and Drill	Willimantic	33.00
9010	High Nitrogen Mixture without Potash	Bristol	54.00
9009	*One Ten Sure Crop*	*Mansfield Depot*	27.00
8903	Stockbridge Five Eight General Crop	Rockville	38.00
8930	Stockbridge Five Ten Early Crop	Rockville	39.00
8902	*Superphosphate with Ammonia 2%*	*Stratford*	....
9083	Superphosphate with Ammonia 3%	Westport	31.00
8901	Superphosphate with Ammonia 4%	Stratford	35.00
9084	Superphosphate with Ammonia 5%	Wapping	36.50
9094	Three Ten All Round	Rockville	33.00
8931	Tobacco Grower 1916	Hazardville	38.00
9011	Two Ten Corn	Norwich	30.00
9085	Two Ten Potato	Brooklyn	29.00
	F. O. Brown, Leonard's Bridge, Conn.		
8967	Special Formula for Potatoes and General Crops	Guilford	34.00
8932	Special for Oats and Top Dressing	Guilford	40.50
	E. D. Chittenden Co., Bridgeport, Conn.		
8989	Vegetable and Onion Grower without Potash	Greens Farms	29.00
	E. B. Clark Seed Co., Milford, Conn.		
8904	Ammoniated Bone Phosphate	Stratford	30.50
	The Coe-Mortimer Co., New York City.		
9086	Connecticut Wrapper Grower without Potash	Somersville	40.00
9287	*Excelsior Potato Fertilizer 1916*	*Manchester*	....
9095	H. G. Ammoniated Superphosphate 1916	Norwich	34.00
9096	Morcoe Top Dresser without Potash	Somersville	55.00
9072	*Prolific Crop Producer 1916*	*Wethersfield*	....
8990	XXV Ammoniated Phosphate 1916	Old Mystic	27.00
	Essex Fertilizer Co., Boston, Mass.		
9170	Potato, Corn and Vegetable Fertilizer	Willimantic	37.00
§9097	Potato Manure	Ellington	40.00
9074	Potato Phosphate	South Manchester	38.00
9098	Tobacco Manure	South Manchester	41.00
9073	XXX Fish Fertilizer	Poquonock	30.00

§ Market Garden and Potato Manure shipped under wrong brand name.

WITHOUT POTASH—(*Continued.*)

Nitrogen.						Phosphoric Acid.							
				Total.					Total.		So-called "Available."		
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, water-*insoluble*.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
....	0.02	0.18	0.96	1.16	0.80	9.30	2.37	0.23	11.90	11.0	11.67	10.0	**8900**
6.82	0.12	0.84	0.65	8.43	7.40	0.01	5.96	1.05	7.02	8.0	5.97	4.0	**9081**
3.83	0.12	0.31	0.75	5.01	5.00	5.59	2.28	1.05	8.92	6.0	7.87	5.0	**9008**
0.98	0.25	1.11	1.14	3.48	3.30	2.86	5.47	1.47	9.80	9.0	8.33	8.0	**9091**
0.81	0.10	0.44	0.67	2.02	1.70	9.20	2.06	0.59	11.85	11.0	11.26	10.0	**9007**
0.14	1.10	0.41	1.31	2.96	2.50	4.61	3.49	1.62	9.72	9.0	8.10	8.0	**8929**
0.10	1.34	1.10	2.38	4.92	4.50	2.76	3.20	0.19	6.15	6.0	5.96	5.0	**9082**
1.16	0.24	0.54	1.58	3.52	3.30	1.02	6.63	0.63	8.28	....	7.65	7.0	**9092**
0.96	0.47	0.58	1.57	3.58	3.30	1.54	6.14	0.67	8.35	....	7.68	7.0	**9093**
0.80	1.10	0.97	0.65	3.52	3.29	6.64	3.62	1.64	11.90	11.0	10.26	10.0	**9127**
3.50	3.82	0.58	0.38	8.28	8.29	4.45	1.75	0.27	6.47	6.0	6.20	5.0	**9010**
0.40	0.32	0.13	0.25	1.10	0.82	5.74	4.13	1.06	10.93	11.0	9.87	10.0	**9009**
0.54	1.92	0.61	1.24	4.31	4.11	5.28	3.11	1.46	9.85	9.0	8.39	8.0	**8903**
0.31	1.93	0.46	1.33	4.03	4.11	6.88	3.40	1.41	11.69	11.0	10.28	10.0	**8930**
0.22	0.40	0.56	0.64	1.82	1.65	5.45	5.26	1.30	12.01	11.0	10.71	10.0	**8902**
0.49	0.75	0.45	0.69	2.38	2.47	7.30	3.86	0.99	12.15	11.0	11.16	10.0	**9083**
0.95	1.25	0.61	0.61	3.42	3.29	7.08	3.61	1.27	11.96	11.0	10.69	10.0	**8901**
0.87	1.51	0.50	1.18	4.06	4.11	5.38	3.44	1.34	10.16	9.0	8.82	8.0	**9084**
0.64	0.46	0.70	0.88	2.68	2.47	5.55	4.68	1.71	11.94	11.0	10.23	10.0	**9094**
1.08	0.08	0.07	3.01	4.24	4.11	1.86	2.64	0.36	4.86	5.0	4.50	4.0	**8931**
0.60	0.52	0.33	0.34	1.79	1.65	6.04	4.05	1.68	11.77	11.0	10.09	10.0	**9011**
0.60	0.52	0.23	0.58	1.93	1.65	6.40	3.92	1.19	11.51	11.0	10.32	10.0	**9085**
0.44	1.36	0.77	0.98	3.55	3.29	6.89	4.27	0.87	12.03	11.0	11.16	10.0	**8967**
1.55	1.55	0.52	1.01	4.63	4.92	4.96	5.36	1.92	12.24	9.0	10.32	8.0	**8932**
1.27	0.15	0.63	0.84	2.89	2.47	7.72	2.96	1.00	11.68	11.0	10.68	10.0	**8989**
0.21	1.95	0.40	0.91	3.47	3.29	7.15	3.25	1.74	12.14	11.0	10.40	10.0	**8904**
1.07	0.12	0.17	3.10	4.46	4.53	1.76	2.31	0.43	4.50	4.0	4.07	3.0	**9086**
0.29	2.14	0.49	1.39	4.31	4.11	7.20	2.61	1.84	11.65	11.0	9.81	10.0	**9287**
1.02	0.86	0.39	0.47	2.74	2.47	6.29	4.07	1.09	11.45	11.0	10.36	10.0	**9095**
3.37	3.91	0.59	1.03	8.90	8.23	3.62	1.86	0.20	5.68	6.0	5.48	5.0	**9096**
0.80	0.95	0.73	1.11	3.59	3.29	5.56	4.43	1.19	11.18	11.0	9.99	10.0	**9072**
....	0.23	0.55	0.27	1.05	0.82	5.44	4.99	1.16	11.59	11.0	10.43	10.0	**8990**
0.38	1.75	0.78	1.23	4.14	4.10	7.89	2.38	1.13	11.40	11.0	10.27	10.0	**9170**
0.51	0.76	0.73	0.81	2.81	2.87	7.89	3.53	0.73	12.15	11.0	11.42	10.0	**9097**
0.68	0.98	1.30	0.34	3.30	3.28	7.13	4.51	0.86	12.50	11.0	11.64	10.0	**9074**
0.48	0.58	1.18	1.94	4.18	4.10	4.02	3.97	1.32	9.31	7.0	7.99	6.0	**9098**
0.33	0.46	1.59	0.44	2.82	2.46	7.80	3.71	0.90	12.41	11.0	11.51	10.0	**9073**

TABLE II—NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station Agent:		
	The L. T. Frisbie Co., New Haven, Conn.		
8970	Connecticut Special for all Crops	New Britain	$35.0
8969	Corn and Grain Fertilizer	Norwich	35.0
9087	Market Garden and Top Dresser	Meriden	58.0
8968	*Potato and Vegetable Grower*	*Guilford*	....
8905	Tobacco Special	Suffield	35.0
9128	Tobacco Special	Windsor	35.0
	International Agricultural Corporation, Buffalo, N. Y.		
9099	Buffalo Farmers Choice	Plainfield	32.0
8991	Buffalo New England Special	West Cheshire	25.5
9314	*Buffalo Standard*	*East Haven*	38.0
9129	Buffalo Tobacco Grower	East Granby	....
†9130	Buffalo Top Dresser	Thompsonville	45.0
†9131	Buffalo Vegetable and Potato	Plainfield	34.0
	Lister's Agricultural Chemical Works, Newark, N. J.		
9135	Atlas Brand Fertilizer 1916	Stratford	.....
9134	Celebrated Tobacco Fertilizer without Potash	Warehouse Point	.....
9133	Complete Tobacco Fertilizer without Potash	Rockville	.....
8992	Plant Food 1916	Hamden	.....
9132	Superior Ammoniated Superphosphate 1916	Danbury	34.0
	Lowell Fertilizer Co., Boston, Mass.		
9137	Animal Brand	Moosup	32.5
9149	Bone Fertilizer	Wallingford	30.0
8971	*Empress Brand*	Southington	29.0
9147	Market Garden Special Grass and Lawn Dressing	Rockville	42.0
9146	*Potato, Corn and Vegetable*	*Warehouse Point*	.....
9136	Potato Manure	Saybrook	37.0
9145	Potato Phosphate	Southington	35.0
9148	Tobacco Grower	Somers	40.0
	E. Manchester and Sons, Winsted, Conn.		
9150	1917 Formula	Ellington	.....
	The Mapes Formula and Peruvian Guano Co., New York City.		
‡8972	5% Ammonia Special	Hartford	38.0
9151	5% Ammonia Special	Ellington	34.0
8973	1917 Special	Norwich	35.0
	National Fertilizer Co., New York City.		
9156	H. G. Top Dressing without Potash	Granby	60.0
9152	Nitrogen Phosphate Mixture No. 1	Winsted	25.0
9153	Nitrogen Phosphate Mixture No. 2	Ridgefield	45.0
9154	Nitrogen Phosphate Mixture No. 3	Newington	.....
8993	Nitrogen Phosphate Mixture No. 4	West Cheshire	33.00
9155	Nitrogen Phosphate Mixture No. 5	Ellington	33.00
9171	Nitrogen Phosphate Mixture No. 6	Ellington	.....
8974	Tobacco Special without Potash	Thompsonville	39.50

WITHOUT POTASH—(*Continued.*)

Nitrogen.						Phosphoric Acid.								
				Total.					Total.		So-called "Available."			
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
0.34	0.48	0.69	0.79	2.30	2.46	7.60	3.43	0.78	11.81	11.0	11.03	10.0	**8970**
0.03	0.09	0.84	0.84	1.80	1.64	6.60	4.00	0.59	11.19	11.0	10.60	10.0	**8969**
0.91	1.44	0.73	1.06	4.14	4.10	7.61	3.23	0.58	11.42	11.0	10.84	10.0	**9087**
0.44	1.29	0.71	0.93	3.37	3.28	7.07	4.13	0.79	11.99	11.0	11.20	10.0	**8968**
0.69	0.09	1.61	1.82	4.21	4.10	3.60	3.75	1.43	8.78	7.0	7.35	6.0	**8905**
0.15	1.01	1.08	2.20	4.44	4.10	3.61	3.99	1.27	8.87	7.0	7.60	6.0	**9128**
0.49	0.05	0.12	0.40	1.06	0.80	6.83	3.00	1.39	11.22	11.0	9.83	10.0	**9099**
0.46	0.12	0.71	0.55	1.84	1.60	3.43	6.90	1.57	11.90	11.0	10.33	10.0	**8991**
1.67	0.08	0.80	0 95	3.50	3.30	3.24	6.58	3.34	13.16	11.0	9.82	10.0	**9314**
0.19	1.90	0.27	1.59	3.95	4.10	2.66	2.38	0.73	5.77	5.0	5.04	4.0	**9129**
2.66	0.83	0.61	0.68	4.78	5.80	2.30	5.66	2.02	9.98	7.0	7.96	6.0	**9130**
1.12	0.09	0.61	0.40	2.22	2.50	4.35	5.24	1.82	11.41	11.0	9.59	10.0	**9131**
1.35	1.44	0.47	1.06	4.32	4.11	6.56	2.32	1.01	9.89	9.0	8.88	8.0	**9135**
0.23	0.07	0.65	3.65	4.60	4.53	2.40	1.16	0.51	4.07	4.0	3.56	3.0	**9134**
1.05	1.04	1.12	0.96	4.17	4.11	1.14	3.84	1.38	6.36	5.0	4.98	4.0	**9133**
0.14	0.22	0.36	0.60	1.32	0.82	5.59	4.67	1.33	11.59	11.0	10.26	10.0	**8992**
0.70	0.28	1.18	1.24	3.40	3.29	2.13	6.15	2.67	10.95	11.0	8.28	10.0	**9132**
0.32	0.58	0.74	0.98	2.62	2.87	7.87	3.55	0.63	12.05	11.0	11.42	10.0	**9137**
0.37	0.11	0.74	0.84	2.06	2.05	6.79	3.43	1.51	11.73	11.0	10.22	10.0	**9149**
0.05	0.07	0.59	0.72	1.43	1.25	7.76	4.00	1.11	12.87	11.0	11.76	10.0	**8971**
0.53	1.66	1.32	1.47	4.98	4.92	5.40	4.05	1.19	10.64	9.0	9.45	8.0	**9147**
0.74	1.49	0.81	0.94	3.98	4.10	8.02	3.15	0.79	11.96	11.0	11.17	10.0	**9146**
0.38	0.65	0.72	0.94	2.69	2.46	7.43	3.83	0.50	11.76	11.0	11.26	10.0	**9136**
0.54	1.22	0.76	0.88	3.40	3.28	7.31	3.80	0.84	11.95	11.0	11.11	10.0	**9145**
0.27	0.05	1.71	2.19	4.22	4.10	4.10	3.23	1.11	8.44	7.0	7.33	6.0	**9148**
0.67	0.44	0.62	1.39	3.12	2.47	6.58	4.02	2.09	12.69	....	10.60	10.0	**9150**
3.50	0.04	0.09	0.50	4.13	4.12	2.74	6.51	2.28	11.53	10.0	9.25	8.0	**8972**
3.72	0.06	0.22	0.53	4.53	4.12	4.97	4.09	2.07	11.13	10.0	9.06	8.0	**9151**
2.96	0.03	0.29	0.50	3.78	3.29	4.94	4.18	1.56	10.68	10.0	9.12	8.0	**8973**
2.59	4.03	1.30	1.03	8.95	8.23	3.70	2.03	0.27	6.00	6.0	5.73	5.0	**9156**
0.03	0.10	0.36	0.52	1.01	0.82	4.67	5.95	1.01	11.63	11.0	10.62	10.0	**9152**
0.45	0.55	0.18	0.64	1.82	1.65	7.31	3.32	1.27	11.90	11.0	10.63	10.0	**9153**
0.36	0.62	0.52	1.03	2.53	2.47	6.25	4.25	1.01	11.51	11.0	10.50	10.0	**9154**
0.78	1.35	0.50	0.66	3.29	3.29	6.44	4.27	1.42	12.13	11.0	10.71	10.0	**8993**
1.62	1.13	0.66	0.80	4.21	4.11	5.60	3.48	1.56	10.64	9.0	9.08	8.0	**9155**
0.28	2.26	0.41	1.39	4.34	4.11	6.92	3.15	1.57	11.64	11.0	10.07	10.0	**9171**
1.28	0.08	0.01	3.58	4.95	4.53	1.53	2.41	0.54	4.48	4.0	3.94	3.0	**8974**

TABLE II—NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station Agent:		
	New England Fertilizer Co., Boston, Mass.		
9172	Corn and Grain Fertilizer	Rockville	$29.00
9223	Corn Phosphate	Madison	.....
9222	High Grade Potato Fertilizer	North Haven	36.00
†9173	Potato Fertilizer	Rockville	34.00
9174	Special Tobacco Manure	Warehouse Point	40.00
8994	Superphosphate	Meriden	35.00
	Olds and Whipple, Hartford, Conn.		
9175	High Grade Tobacco Starter	Windsor	.....
9176	Special Grass Fertilizer	Hartford	38.50
8995	Special Phosphate	Silver Lane	33.50
9052	Tobacco Special Fertilizer	Hartford	37.50
9053	Tobacco Special Fertilizer	Hartford	37.50
9054	Tobacco Special Fertilizer	Hartford	37.50
9055	Tobacco Special Fertilizer	Hartford	37.50
	Parmenter and Polsey Fertilizer Co., Boston, Mass.		
9177	Grain Grower	Plantsville	30.00
8975	Plymouth Rock Brand	Highwood	.....
9178	Potato Fertilizer	Bloomfield	32.00
9317	Special Tobacco Grower	Windsor	40.00
9179	Star Brand Superphosphate	Plantsville	32.00
	The Rogers and Hubbard Co., Portland, Conn.		
8996	Hubbard's Bone Base Oats and Top Dressing	Branford	52.00
9180	Hubbard's Bone Base Soluble Corn and General Crops Manure	Branford	38.00
9193	Hubbard's Bone Base Soluble Tobacco Manure	Portland	41.50
9199	Rogers' All Soils—All Crops Phosphate	Portland	.....
9200	Rogers' Climax Tobacco Brand	Portland	.....
9195	Rogers' Complete Phosphate	Black Hall	30.00
9201	Rogers' H. G. Oats and Top Dressing	Somers	.....
9202	Rogers' H. G. Soluble Corn and Onion Manure	Black Hall	35.00
*8997	Rogers H. G. Soluble Tobacco Manure	Milford	45.00
*9347	Rogers' H. G. Soluble Tobacco Manure	Wapping	43.00
9203	Rogers' Potato Phosphate	Mansfield Depot	34.00
9194	R. and H. All Soils—All Crops Phosphate	Wethersfield	.....
9196	R. and H. Complete Phosphate	Willimantic	33.00
9197	R. and H. Potato Phosphate	Stafford Springs	40.00
9198	R. and H. Valley Tobacco Brand	Portland	.....
	F. S. Royster Guano Co., Baltimore, Md.		
*9225	Curfew Ammoniated Superphosphate	Branford	37.00
*9348	Curfew Ammoniated Superphosphate	Madison	34.00
*9228	Goodwill Ammoniated Superphosphate	Plainville	39.50
*9404	Goodwill Ammoniated Superphosphate	Windsor	38.25
9227	Innovation Ammoniated Superphosphate	Branford	32.00
9204	Penguin Ammoniated Superphosphate	Waterbury	30.00
9229	Stevens' Formula	Glastonbury	36.00
9226	Valley Tobacco Compound	Windsor	38.50

† See page 387. * See page 393.

WITHOUT POTASH—(*Continued.*)

Nitrogen.						Phosphoric Acid.							
				Total.					Total.		So-called "Available."		
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
.04	0.12	0.51	0.69	1.36	1.23	5.91	3.72	1.83	11.46	11.0	9.63	10.0	9172
.10	0.42	0.72	0.78	2.02	2.05	7.58	3.74	0.91	12.23	11.0	11.32	10.0	9223
.63	1.12	0.63	0.93	3.31	3.28	7.46	3.72	0.87	12.05	11.0	11.18	10.0	9222
.30	0.62	0.92	0.49	2.33	2.46	5.53	4.00	2.12	11.65	11.0	9.53	10.0	9173
.71	0.09	1.01	2.29	4.10	4.10	4.09	3.53	1.18	8.80	7.0	7.62	6.0	9174
.59	0.78	0.71	0.90	2.98	2.87	7.65	3.67	0.58	11.90	11.0	11.32	10.0	8994
.37	0.21	0.21	5.85	9.64	9.06	2.49	2.41	0.60	5.50	3.0	4.90	3.0	9175
.92	0.10	0.75	2.78	5.55	4.95	0.79	3.24	3.07	7.10	4.0	4.03	4.0	9176
.58	0.04	0.89	2.07	4.58	4.11	0.56	3.28	3.54	7.38	4.0	3.84	4.0	8995
.96	0.07	0.39	3.08	4.50	4.11	1.65	2.14	0.37	4.16	3.0	3.79	3.0	9052
...	....	....	....	4.31	4.11	....	....	....	3.94	3.0	.....	....	9053
...	....	....	....	4.16	4.11	....	....	....	3.58	3.0	.....	....	9054
...	....	....	....	4.26	4.11	....	....	....	3.67	3.0	.....	....	9055
.05	0.06	0.70	0.68	1.49	1.23	7.99	2.96	0.97	11.92	11.0	10.95	10.0	9177
.56	0.78	0.83	0.99	3.16	2.88	7.51	3.89	0.60	12.00	11.0	11.40	10.0	8975
.04	0.50	0.73	0.76	2.63	2.05	7.40	3.75	0.75	11.90	11.0	11.15	10.0	9178
.18	0.04	1.50	2.18	3.90	4.10	4.08	3.44	1.24	8.76	7.0	7.52	6.0	9317
.32	0.69	0.62	0.79	2.42	2.46	7.11	3.55	0.55	11.21	11.0	10.66	10.0	9179
.31	0.14	0.37	0.44	6.26	6.00	0.00	6.52	6.32	12.84	12.0	6.52	6.0	8996
.54	0.84	0.33	0.79	2.50	2.50	1.45	7.78	4.55	13.78	12.0	9.23	10.0	9180
.97	0.79	0.43	0.85	5.04	5.00	0.02	9.33	3.51	12.86	12.0	9.35	10.0	9195
.53	0.15	0.13	0.68	3.49	3.30	3.70	3.96	1.41	9.07	8.0	7.66	7.0	9199
.93	1.10	0.29	2.50	4.82	4.12	0.03	1.98	1.88	3.89	4.0	2.01	3.0	9200
.20	0.05	0.27	0.57	1.09	1.00	3.67	3.38	2.61	9.66	9.0	7.05	8.0	9196
.71	0.14	0.26	0.38	6.49	6.00	0.00	6.58	5.65	12.23	12.0	6.58	6.0	9201
.54	0.70	0.51	0.86	2.61	2.50	0.78	8.73	4.63	14.14	12.0	9.51	10.0	9202
.61	1.75	0.60	1.04	5.00	5.00	0.07	8.65	4.25	12.97	12.0	8.72	10.0	8997
.20	1.32	0.50	0.91	4.93	5.00	0.21	8.51	4.12	12.84	12.0	8.72	10.0	9347
.45	0.56	0.55	0.66	2.22	2.00	6.36	5.47	3.85	15.68	14.0	11.83	13.0	9203
.66	0.34	0.48	0.52	4.00	3.30	2.15	4.55	2.15	8.85	8.0	6.70	7.0	9194
.17	0.21	0.37	0.71	1.46	1.00	3.77	3.60	2.92	10.29	9.0	7.37	8.0	919
.32	1.02	0.21	0.62	2.17	2.00	9.58	4.89	1.29	15.76	14.0	14.47	13.0	919
.68	0.28	0.25	2.53	4.74	4.12	0.12	1.86	1.97	3.95	4.0	1.98	3.0	919
.07	1.32	0.63	1.00	3.02	3.29	6.69	2.34	0.73	9.76	8.5	9.03	8.0	922
.04	1.50	0.55	1.13	3.22	3.29	6.16	2.06	0.59	8.81	8.5	8.22	8.0	934
.16	1.80	0.50	1.38	3.84	4.11	6.57	1.96	0.49	9.02	8.5	8.53	8.0	922
.14	1.92	0.46	1.68	4.20	4.11	6.89	1.57	0.51	8.97	8.5	8.46	8.0	940
.04	1.03	0.50	0.88	2.45	2.47	6.00	2.29	0.68	8.97	8.5	8.29	8.0	922
.12	0.82	0.24	0.50	1.68	1.65	6.28	3.88	1.37	11.53	10.5	10.16	10.0	920
.16	0.89	0.37	2.59	4.01	4.11	3.59	2.60	1.04	7.23	6.5	6.19	6.0	922
.25	0.67	0.30	2.89	4.11	4.11	3.27	2.71	0.77	6.75	6.5	5.98	6.0	922

TABLE II—NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station Agent:		
	Sanderson Fertilizer and Chemical Co., New Haven, Conn.		
*8907	H. G. Ammoniated Phosphate	Stratford	$33.00
*9075	H. G. Ammoniated Phosphate	*Orange*	30.50
*9308	H. G. Ammoniated Phosphate	Highwood	.....
9224	Phosphate without Potash	Plainville	30.00
8906	Special without Potash	Stratford	29.25
	The C. M. Shay Co., Groton, Conn.		
9231	4–8	Groton	33.00
	M. L. Shoemaker and Co., Philadelphia, Pa.		
8998	"Swift-Sure" Superphosphate for Tobacco and General Use	Hartford	39.00
	Springfield Rendering Co., Springfield, Mass.		
9230	Animal Fertilizer	Thompsonville	33.00
	Virginia-Carolina Chemical Co., New York City.		
9233	Ammoniated Bone Phosphate for all Crops	Norwich	28.00
8999	H. G. Corn and Vegetable Compound without Potash	Norwich	32.00
9232	Indian Brand for Tobacco (C. S. M.) without Potash	Glastonbury	35.65
9309	Special Top Dresser	Milford	40.00
9310	20th Century Potato Manure without Potash	Winsted	37.00
	Wilcox Fertilizer Co., Mystic, Conn.		
9311	Complete Bone Superphosphate	Rockville	26.00
9048	Corn Special	Hartford	34.50
8886	Grass Fertilizer	Meriden	30.50
	Worcester Rendering Co., Auburn, Mass.		
9312	Royal Worcester Corn and Grain Fertilizer	Norwich	28.00
9313	Royal Worcester Potato and Vegetable Fertilizer	Norwich	33.00
	Sampled by Purchasers and Others:		
8713	Amer. Agr. Chem. Co.'s Complete Tobacco Fertilizer without Potash	*E. Windsor Hill:*—Keiser & Boasberg Plant.	37.50
8714	Amer. Agr. Chem. Co.'s Complete Tobacco Fertilizer without Potash	*E. Windsor Hill:*—Keiser & Boasberg Plant.	37.50
8715	Amer. Agr. Chem. Co.'s Complete Tobacco Fertilizer without Potash	*E. Windsor Hill:*—Keiser & Boasberg Plant.	37.50
8716	Amer. Agr. Chem. Co.'s Complete Tobacco Fertilizer without Potash	*E. Windsor Hill:*—Keiser & Boasberg Plant.	37.50
9400	Amer. Agr. Chem. Co.'s Grain and Seeding Fertilizer	*Stafford:*—F. L. Upham	27.00

* See page 393.

WITHOUT POTASH—(*Continued.*)

Nitrogen.						Phosphoric Acid.							
				Total.					Total.		So-called "Available."		
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
0.48	0.12	1.13	1.66	3.39	3.29	2.62	6.49	6.82	15.93	11.0	9.11	10.0	**8907**
1.58	0.15	0.40	1.51	3.64	3.29	8.82	3.74	1.33	13.89	11.0	12.56	10.0	**9075**
1.60	*0.11*	*0.73*	*0.96*	*3.40*	*3.29*	*4.62*	*6.29*	*0.49*	*11.40*	*11.0*	*10.91*	*10.0*	**9308**
0.18	0.13	0.56	0.95	1.82	1.65	1.97	8.22	2.26	12.45	11.0	10.19	10.0	**9224**
0.35	0.13	0.74	1.45	2.67	2.47	4.11	6.08	4.14	14.33	11.0	10.19	10.0	**8906**
0.76	0.12	1.45	1.11	3.44	3.28	3.26	5.20	1.89	10.35	10.0	8.46	8.0	**9231**
1.06	0.05	0.96	1.63	3.70	3.29	6.97	4.21	1.59	12.77	12.0	11.18	9.0	**8998**
0.50	*0.45*	*1.01*	*0.81*	*2.77*	*2.46*	*8.43*	*3.20*	*0.42*	*12.05*	*11.0*	*11.63*	*10.0*	**9230**
0.12	0.78	*0.39*	*0.51*	*1.80*	*1.65*	*6.66*	*2.77*	*1.37*	*10.80*	*11.0*	9.43	10.0	**9233**
0.01	1.05	0.70	0.89	2.65	2.47	7.80	2.78	0.93	11.51	11.0	10.58	10.0	**8999**
1.12	0.46	0.41	2.13	4.12	4.11	1.57	2.42	6.41	10.40	5.0	3.99	4.0	**9232**
0.24	1.58	1.32	1.76	4.90	4.94	6.51	2.01	1.78	10.30	9.0	8.52	8.0	**9309**
0.21	*1.91*	*0.68*	*1.48*	4.28	*4.12*	*9.01*	*1.64*	*0.86*	*11.51*	*11.0*	*10.65*	10.0	**9310**
0.79	0.28	0.15	1.24	2.46	1.65	7.91	2.71	0.88	11.50	11.0	10.62	10.0	**9311**
0.55	*0.14*	*0.73*	*2.30*	*3.72*	*3.30*	*4.22*	*5.43*	*3.57*	*13.22*	*11.0*	*9.65*	*10.0*	**9048**
2.67	0.05	1.84		4.56	4.12	7.39	3.41	1.25	12.05	9.0	10.80	8.0	**8886**
0.85	0.58	0.68	0.61	2.72	2.05	8.49	5.19	3.03	16.71	11.0	13.68	10.0	**9312**
1.35	0.45	1.16	1.29	4.25	3.28	5.20	5.25	4.03	14.48	11.0	10.45	10.0	**9313**
....	....	....	....	4.52	4.53	....	....	....	4.64	4.0	.....	3.0	**8713**
....	....	....	....	4.58	4.53	....	....	....	4.72	4.0	.....	3.0	**8714**
....	....	....	....	4.52	4.53	....	....	....	4.50	4.0	.....	3.0	**8715**
....	....	....	....	4.66	4.53	....	....	....	4.43	4.0	.....	3.0	**8716**
0.73	0.74	0.73		2.20	1.65	6.52	3.95	1.56	12.03	11.0	10.47	10.0	**9400**

TABLE II—NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Purchasers and Others:		
8737	Quinnipiac Wrapper Brand	*Hartford*:—Haviland Tobacco Co.	$37.50
8738	Quinnipiac Wrapper Brand	*Hartford*:—Haviland Tobacco Co.	37.50
8739	Quinnipiac Wrapper Brand	*Hartford*:—Haviland Tobacco Co.	37.50
8962	Apothecaries Hall Co.'s Victor Potato Special	*West Cheshire*:—Whitcomb & Hadley	36.00
9144	Frisbie's Tobacco Fertilizer	*Suffield*:—E. S. Seymour	32.50
9138	Rogers & Hubbard's All Soils—All Crops Phosphate	*Portland*:—John Gotta.	31.00
9139	Hubbard's Bone Base Soluble Tobacco Manure	*Portland*:—John Gotta.	42.00
§8751	Royster's Valley Tobacco Compound	*Avon*:—P. H. Woodford	.....
8766	Royster's Valley Tobacco Compound	*New Milford*:—L. W. Marsh	.....
9394	Sanderson's High Grade Ammoniated Phosphate	*Branford*:—A. E. Plant Sons Co.	.....
9060	Sanderson's High Grade Ammoniated Phosphate	*Cheshire*:—T. L. Chipman	.....
9395	Sanderson's Top Dresser	*Branford*:—A. E. Plant Sons Co.	.....
9407	Shay's 4–10	*New London*:—J. M. Graves	37.00
8810	Virginia-Carolina Chem. Co.'s Indian Brand for Tobacco without Potash	*Addison*:—Chas. Bell.	35.65
8774	Unknown brand	*Cornwall*:—O. E. Temple	.....
8861	5–10 Fertilizer	*Roxbury*:—J. G. Butler	.....

§Contains .078% of potash as muriates.

WITHOUT POTASH—(*Concluded.*)

Nitrogen.						Phosphoric Acid.							
				Total.					Total.		So-called "Available."		
In Nitrates.	In Ammonia.	Organic water-soluble.	Organic water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
....	....	....	....	4.58	4.53	....	....	....	4.22	4.0	.....	3.0	**8737**
....	....	....	....	4.76	4.53	....	....	....	4.48	4.0	.....	3.0	**8738**
....	....	....	....	4.58	4.53	....	....	....	4.80	4.0	.....	3.0	**8739**
....	....	....	....	2.65	2.47	....	....	....	15.48	11.0	.....	10.0	**8962**
....	....	....	....	3.90	4.10	....	....	....	8.30	7.0	.....	6.0	**9144**
....	....	....	....	3.34	3.30	....	....	....	9.31	8.0	.....	7.0	**9138**
....	....	....	....	5.10	5.00	....	....	....	12.59	12.0	.....	10.0	**9139**
....	....	....	....	4.35	4.11	....	....	....	6.97	....	.....	6.0	**8751**
....	....	....	....	4.45	4.11	....	....	....	6.68	....	.....	6.0	**8766**
....	....	....	....	3.39	3.29	....	....	....	11.78	11.0	.....	10.0	**9394**
....	....	....	....	3.40	3.29	....	....	....	10.96	11.0	.....	10.0	**9060**
....	....	....	....	3.39	3.29	....	....	....	12.60	11.0	.....	10.0	**9395**
0.11	0.38	2.45		2.94	3.29	2.11	4.36	1.42	7.89	....	6.47	10.0	**9407**
....	....	....	....	4.06	4.12	....	....	....	4.95	5.0	.....	4.0	**8810**
....	....	....	....	1.11	....	....	....	....	8.32	....	.....	....	**8774**
....	....	....	....	4.26	4.12	....	....	....	11.71	....	.....	10.0	**8861**

VI. MISCELLANEOUS FERTILIZERS, LIME, ASHES, ETC.

SHEEP MANURE.

9211. Pulverized Sheep Manure. Sold by American Agricultural Chemical Co., New York City. Stock of Geo. S. Phelps & Co., Thompsonville.

9206. Sheep Manure. Sold by L. T. Frisbie Co., New Haven. Sampled and sent by F. S. Burnett, New Haven.

9349. Sheep Manure. Sold by L. T. Frisbie Co., New Haven. Stock of G. F. Peters & Son, Highwood.

9267. Sheep's Head Pulverized Sheep Manure. Sold by Natural Guano Co., Aurora, Ill. Stock of Frank S. Platt Co., New Haven.

9270. Wizard Brand Manure. Sold by Pulverized Manure Co., Chicago. Stock of Frank S. Platt Co., New Haven.

8896. Pulverized Sheep Manure. Sampled and sent by H. E. Larsen, Mt. Carmel.

9713. Chicago Feed & Fertilizer Co.'s Ground Sheep Manure. For analysis see page 422.

Station No.	9211	9206	9349	9267	9270	8896
Per cent. of						
Nitrogen as nitrates	0.10	...	0.12	....	....	....
" as ammonia	0.14	...	0.02	0.22	0.26	....
" as organic	1.94	....	1.45	1.93	1.72	....
" total found	2.18	2.07	1.59	2.15	1.98	2.31
" total guaranteed	2.06	....	0.82	2.25	1.80	....
Phosphoric acid, water-soluble	1.04	....	0.17	0.76	0.85	....
" " citrate-soluble	0.36	....	1.67	0.79	0.50	....
" " citrate-insoluble	0.15	....	0.22	0.13	0.13	....
" " total found	1.55	2.52	2.06	1.68	1.48	2.99
" " total guaranteed	1.25	....	2.00	1.25	1.00	....
Water-soluble potash found	1.81	0.97	0.74	3.14	2.00	1.03
" " guaranteed	1.00	....	0.97	1.50	1.00	....
Chlorin	....	....	0.08	0.38	0.90	....
Cost per ton	$38.00	....	....	31.00	31.00	35.00

These dried manures are chiefly of interest to florists and to greenhouse or lawn owners. As we have said in previous reports, they are out of the question for general farm use, because horse manure supplies three or four times as much plant food for the same money, and the extra vegetable matter should be supplied in farm crops and residues.

WOOD ASHES.

Twenty samples called "wood ashes" were analyzed. Three of these, **8862, 8811** and **8698,** have the character of lime-kiln ashes and contain very little potash. The remaining samples are good, bad or indifferent. Nine samples contained from 4.7 to 6.8 per cent. of potash; four from 2.8 to 3.7 per cent., and four from 0.8 to 1.7 per cent.

The prices were exceedingly variable; for instance, $9.00 per ton for material containing 2.8 per cent. of potash; $16.00 for ashes containing 1.5 per cent. and $27.50 for one containing 4.72 per cent. Certain of the higher grades were sold on the unit basis, the price ranging from $4.50 to $6.00 per unit of water-soluble potash.

The extreme variability in the potash content of wood ashes emphasizes the necessity of always buying it on a definite guaranty of water-soluble potash.

Only three of the samples were accompanied by a guaranty, **9372, 9025** and **8862.** These were guaranteed 2.00, 5.03 and 3.00 per cent. of potash, respectively, and contained 1.50, 4.72 and 0.07 per cent.

HOUSEHOLD WASTES.

At the present time, when the prices for potash fertilizers are almost prohibitive, any available source of this important element is a matter of interest. Possibly few householders realize the fertilizer value of many of their household wastes which they usually throw away. The actual content of potash in any of these is small, but may be worth saving.

The samples, whose analyses are given in the accompanying table, were for the most part prepared by Prof. P. E. Browning, of Yale University, and submitted by him to us for analysis. It is to be regretted that the actual percentages of ash were not determined, as the information thus supplied would have been valuable. The results, however, are suggestive, and indicate how much valuable fertilizer material in the aggregate is thrown away by the American public. Many of these ashes could be prepared in the ordinary open fireplace of the average home and could be collected with the ashes from the wood there burned. The citrus fruit skins, because of their oil, burn readily, and our analyses show how rich in potash their ashes are. The analyses also suggest the utility of community incinerating plants as a means of conserving the important amounts of potash which some household wastes contain.

ANALYSES OF WOOD ASHES.

Station No.	Car No. and Purchaser or Dealer.	Water.	Insoluble in acid (sand)	Water-soluble Potash.	Lime.	Phosphoric Acid.	Cost per ton.
9372	John Joynt, Lucknow, Ont. I. Lockwood, New Canaan	....	....	1.50	29.27	1.29	$16.00
8771	John Joynt, Lucknow, Ont. 103660 J. E. Lathrop, East Hartford	....	36.17	1.54	....	....	....
8949	Olds & Whipple, Hartford. 64531 J. B. Stewart, Windsor	....	12.45	6.56	33.62	2.01	*
8950	Olds & Whipple, Hartford. 7813 E. P. Brewer, Silver Lane	....	10.43	6.15	35.04	2.17	*
8765	Olds & Whipple, Hartford. 17976 C. F. Segee, East Hartford	....	6.66	5.03	....	....	....
9020	Olds & Whipple, Hartford. 24976 John Wolf, Windsor	....	....	6.39	....	....	*
9025	Olds & Whipple, Hartford. H. W. Ferry, So. *Glastonbury*	....	6.60	4.72	36.86	2.00	27.50
9253	Olds & Whipple, Hartford. 3719 W. S. Pinney, Suffield (John Joynt)	....	....	6.50	....	....	*
9391	Olds & Whipple, Hartford. 76590 James Conroy, Warehouse Point	....	....	0.73	....	1.44	*
9140	J. E. Perkins, Warehouse Point. 29942 A. E. Pascoe, Warehouse Point	....	....	2.82	25.88	1.93	9.00
8862	John Meehan & Son, N. Y. City. K. Tobacco Corp., Tariffville	10.45	7.66	0.07	52.70	0.22	15.00
9219	W. L. Mitchell, New Haven. Comstock, Ferre & Co., Wethersfield	....	....	3.66	....	....	....
8951	W. L. Mitchell, New Haven. 76551 K. C. Kulle, Suffield	....	10.92	5.84	34.42	1.78	†
8895	W. L. Mitchell, New Haven. 8507 K. C. Kulle, Suffield	....	....	6.78	....	2.55	....
8757	Chas. Stevens, *Napanee, Ont.* *Albert Carini, So. Glastonbury*	....	17.79	3.25	....	....	....
8811	Roy Hayes, Granby. E. H. Rollins, Granby	....	8.29	0.11	....	0.20	15.50
8933	E. M. Brown, Hartford	....	13.95	2.83	29.97	1.30	....
9021	M. E. Crawford, New Canaan	....	13.37	1.71	32.42	1.52	....
9023	N. Jones, So. Windsor	....	13.24	6.04	31.50	1.65	....
8698	Conn. Sumatra Tobacco Co., Hartford	....	....	0.08	....	....	....

* $6 per unit of potash.

† $4.50 per unit of potash.

ANALYSES OF THE ASHES OF HOUSEHOLD WASTES.

	Phosphoric Acid.	Water-Soluble Potash.
Apple Skin Ash	3.08	11.74
Banana Skin Ash	3.25	41.76
Banana Stalk Ash (yellow)	2.34	49.40
Banana Stalk Ash (red)	3.04	46.64
Banana Stalk Ash (soluble salts)	?	45.28
Banana Stalk juice, evaporated, acidified	1.91	35.58
Banana Stalk juice, evaporated	2.25	4020.*
Cantaloupe Rind Ash	9.77	12.21
Cigar and Cigarette Ashes	2.57	16.81
Coal Ashes, sifted	0.32	0.16
Coffee Grounds (percolated)	0.36	0.67†
Cucumber Skin Ash	11.28	27.20
Egg Shells, burned	0.43	0.29‡
Grape Fruit Skin Ash	3.58	30.64
Grape Fruit Skin Ash (soluble salts)	?	56.92
Maine Coast Kelp Ash	1.93	21.70
Orange Skin Ash	2.90	27.04
Peach Skin Ash	6.31	30.76
Peach Stone Ash	3.25	6.04
Peanut Shell Ash	1.23	6.45
Pea Pod Ash	1.79	9.00
String Beans Ash (stems and strings)	4.99	18.09
Sweet Potato Skin (boiled) Ash	3.29	13.89
Tea Leaves Ash	1.60	0.44
White Potato Skin (raw) Ash	5.18	27.54
Wood Ashes	1.06	6.41
Wood Ashes, after burning citrus fruit skins	1.13	3.22

GROUND LIMESTONE.

8686. Grangers' Lime Co., West Stockbridge, Mass. Stock of Walter Hine, Orange. Cost $3.50 per ton.

8700. Grangers' Lime Co., West Stockbridge, Mass. "200 Mesh." Stock of J. W. Alsop, Avon.

8736. Grangers' Lime Co., West Stockbridge, Mass. "200 Mesh." Stock of H. K. Taylor, Griffins.

8709. Grangers' Lime Co., West Stockbridge, Mass. "200 Mesh." Stock of W. J. Reeves, Windsorville.

9534. Grangers' Lime Co., West Stockbridge, Mass. Stock of S. Heath, New Canaan.

ANALYSES OF LIMESTONE.

Station No.	**8686**	**8700**	**8736**	**8709**	**9534**
Per cent. of					
Lime	37.96	50.60	50.35	50.62	52.08
Magnesia	8.54	§	§	§	0.77
Insoluble in acid	14.68	6.35	6.81	6.24	7.22

* Contains also 0.45% nitrogen.
† Contains also 1.99% nitrogen.
‡ Contains also 52.12% lime.
§ Not determined.

8686 contains 67.72 per cent. of calcium carbonate and 17.85 per cent. of magnesium carbonate. The other four samples are quite pure calcitic limestones, containing from 89.84 to 92.91 per cent. of calcium carbonate.

HUMUS, MUCK, PEAT, ETC.

Two samples of commercial humus and five samples of muck were analyzed.

8685. Alphano Humus. Sent by Charles Henderson, Farmington. Cost $10.00 per ton.

9062. Commercial Humus. Sent by Commercial Humus Co., Newark, N. J. Claimed to contain on dry basis; nitrogen 2.60, phosphoric acid 1.10, potash 0.51, lime 2.90, magnesia 0.50, ash 20.12, and organic matter 75 per cent.

8889. Sent by M. F. Dallen, Willimantic, from a deposit stated to be 20 feet deep, covering several acres.

9478, 9479, 9480. Sent by A. Sartore, Waterbury.

8769. Sent by G. L. Cass, So. Britain.

Station No.	**8685**	**9062**	**8889**	**9478**	**9479**	**9480**	**8769**
Composition as received:							
Water	36.72	69.86	8.82	85.99	77.41	68.87	75.51
Mineral matter	22.32	9.83	10.72	1.28	3.18	2.81	11.55
Organic matter	40.96	20.31	80.46	12.73	19.41	28.32	12.94
Nitrogen	1.48	0.52	2.26	0.42	0.54	0.59	0.33
Phosphoric acid	1.11	0.02	*	*	*	*	*
Potash	*	0.03	*	*	*	*	*
Lime	4.19	*	*	*	*	*	*
Insoluble in acid	*11.22*	*	*	*	*	*	*
On water-free basis:							
Mineral matter	35.27	32.61	11.76	9.14	14.08	9.03	47.16
Organic matter	64.73	67.39	88.24	90.86	85.92	90.97	52.84
Nitrogen	2.19	1.73	2.48	3.00	2.39	1.90	1.35
Phosphoric acid	1.75	0.06	*	*	*	*	*
Potash	*	0.11	*	*	*	*	*

The two commercial samples contain much more mineral matter and, consequently, less vegetable matter than four of the samples from local deposits. It will be noted that **9062** contains less of all the ingredients claimed except mineral matter, containing only two-thirds of the nitrogen, one-twentieth of the phosphoric acid and one-fifth of the potash claimed.

---

* Not determined.

TOBACCO WASTES.

8410. Tobacco Stems. Sold by Olds and Whipple, Hartford. Sampled and sent by H. E. Wells, East Windsor Hill.

8851. Tobacco Stems. Sampled and sent by A. T. Henry, Wallingford.

8850. Tobacco Waste Ash. Sampled and sent by A. T. Henry, Wallingford.

8848. Tobacco Dust. Sampled and sent by J. Rosenberg & Co., Hartford.

8702. Tobacco Dust. Sampled and sent by Morgan & Dickinson, Windsor.

	8410	8851	8850	8848	8702
Nitrogen	1.97	2.80	....	2.78	1.64
Phosphoric acid	0.56	0.79	1.10	0.69	0.42
Potash, total	6.67	5.27	6.10	2.88	2.50

MISCELLANEOUS MATERIALS.

9339. Spent Hops. Sent by Arthur Mather, Hartford.

Water	79.50
Mineral matter	1.52
Organic matter	18.98
Nitrogen	0.81
Phosphoric acid	0.31
Potash	0.05

9141. Coffee Chaff. Sent by Morris West, Glastonbury. It contained nitrogen 1.92, phosphoric acid 0.15 and potash 1.63 per cent.

8959. Coffee Grounds. Waste from manufacture of G. Washington Coffee. Sent by manufacturer.

Nitrogen	0.81
Phosphoric acid	0.016
Potash	0.166
Water	60.50

8952. Ground Star Fish. Sent by F. L. Homan, New Haven.

Nitrogen	4.48
Phosphoric acid	0.42
Lime	24.32

8953. Musselizer ("Mussel Mud," "Nature's Own Fertilizer"). Sold by Agricultural Development Co., Lewiston, Me. Sent by F. P. Hubbard, Middletown.

8854. Marsh and Marine Mud. Sent by G. D. Tillinghast, Westerly.

	8953	8854
Nitrogen	0.82	0.28
Phosphoric acid	....	0.09
Potash	0.18	0.03

8632. Kelp. Sent by E. E. Burwell, New Haven. It contained nitrogen 1.83, phosphoric acid 0.64 and potash 2.64 per cent.

8749. Chimney Soot. Sent by Donahoe Bros., Middletown. It contained 0.31 per cent. of nitrogen.

8759. Ashes from factory sweepings. Sent by Waterbury Mfg. Co., Waterbury. It contained 0.08 per cent. of potash and 70.02 per cent. of material insoluble in acid. Copper was present.

9280. Lye used for cleaning type. Sent by W. C. Sharpe, Seymour. It contained 0.34 per cent. of potash, no nitrogen, traces of phosphoric acid and sulphates, and much carbonate. Its reaction was strongly alkaline.

8855. Sample apparently incorrectly tagged "Dry Ground Fish." Stock of George S. Phelps Co., Thompsonville. A mixed fertilizer of unknown brand. It contained 5.15 nitrogen, 8.18 "available" phosphoric acid, 9.54 total phosphoric acid and 0.86 per cent. potash.

SOILS.

Six samples of soils were tested for acidity. The details are of no general interest.

9713. Ground Sheep Manure. Sold by the Chicago Feed & Fertilizer Co., Chicago. Sampled and sent by the F. S. Platt Co., New Haven. Contained—nitrogen, 2.74; total phosphoric acid, 2.84; water-soluble potash, 2.07; guaranteed respectively 1.85, 1.50 and 1.25 per cent.

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 205 APRIL, 1918

ENTOMOLOGICAL SERIES, No. 25

BEEKEEPING FOR CONNECTICUT

By A. W. YATES

CONTENTS

	Page
Officers and Staff of Station	424
Beekeeping for Connecticut	425
Hives	427
The Standard or Langstroth Hive	427
The Super	428
The Frame	429
The Sectional Brood Chamber Hive	429
Smokers	431
Veils	431
Hive Tool	431
Comb Foundation	432
Stocking with Bees	432
The Colony	433
Workers	434
Drones	434
Races of Bees	434
Location	435
Swarm Control	435
Comb Honey	436
Extracted Honey	437
When to Put on Supers	437
The Extractor	438
Care of Extracted Honey	438
Honey and Its Uses	439
Honey Plants	439
Diseases of Bees	441
American Foul Brood	441
European Foul Brood	442
How Foul Brood Diseases are Spread	444
Treatment	444
Disinfection	445
Apiary Inspection in Connecticut	445
Publications on Beekeeping	446

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BEEKEEPING FOR CONNECTICUT.

By A. W. Yates.

Introduction.

Beekeeping is a possible source of both pleasure and profit requiring a small amount of attention. Honey has considerable value as food, and in these days of food conservation and shortage of sugar, its value is correspondingly greater than in normal times. Beeswax is also valuable and both honey and wax find a ready market. Beekeeping has never been properly developed in Connecticut. There are many beekeepers, each with a few colonies, but in most cases the bees are left to shift for themselves. There is need of more bees in the hands of energetic beekeepers, who will give them more intelligent care.

The outlook for honey production never was better, from the money standpoint, than at present, and the possibilities, through the suppression and control of infectious diseases, are much greater in recent years; therefore it is hoped that this bulletin, while not complete or by any means final, may encourage more people to keep bees, and induce those who already have them to give them better care, so that beekeeping and honey production generally will be much improved. Bees on the farm, if rightly managed, will prove very often the best paying investment the farmer has for the amount of capital and time expended, and farmers who become interested in apiculture will often find that the profits far exceed their expectations. Bees not only are valuable as honey producers but are of great value as pollen carriers, fertilizing a great many fruit and vegetable crops, thus increasing their productiveness.

The sting, no doubt, is the reason why beekeeping is not more popular. This, however, can be almost entirely avoided by the use of the smoker and veil, and by the keeping of races of bees that are less prone to stinging. Of course, all honey-gathering bees have stings and will use them when aroused, but some races, such as the Italians and Carniolans, are much less given to using them.

Almost any persons, except those of a nervous temperament, can keep bees if they desire. Although there are many hundreds of beekeepers in the state, only a very small percentage make apiculture their sole occupation. There are locations, without doubt, where an experienced beekeeper would be well paid for devoting his whole time to the pursuit. Almost any location in

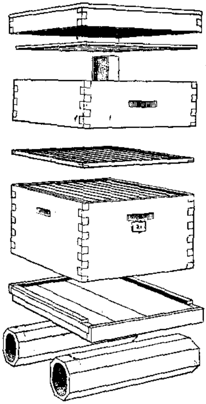


Figure 5. A ten-frame hive with comb-honey super and perforated zinc queen excluder. (After Phillips, Bureau of Entomology, U. S. Department of Agriculture.)

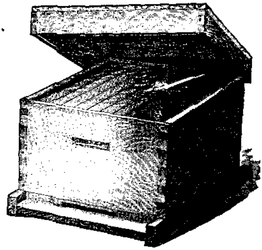


Figure 6. One-story Standard hive with metal cover. (After the A. I. Root Co.)

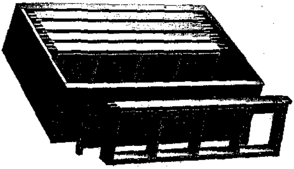


Figure 7. New Special section-frame super. (After the A. I. Root Co.)

the state would support a few colonies with profit to their owner. Backyards in cities and villages, or barren places in the country, could be utilized for this purpose with surprising results.

Beekeeping is also popular with invalids and people of sedentary habits, affording them mental relief and healthful, outdoor exercise. The apiary inspectors of this department are always ready to give instruction or information to those desiring it. One or more of

the text books or pamphlets listed in the back of this bulletin will be found helpful.

The hives and accessories illustrated and described in the following pages are such as have been tested by practical beekeepers and can be recommended to the beginner.

He must remember, however, that beekeeping is no "get-rich-quick" scheme. To succeed and to secure a crop of honey requires work, and work at the right time. A little delay at such times may spell failure. Poor seasons intervene when colonies will have to be fed to take them through the winter and it may need a good deal of enthusiasm on the part of the beekeeper to keep up his courage. These seasons, however, do not occur very often and the practical beekeeper knows that he must make the best of them.

Hives.

Before starting beekeeping it is well to decide on the style of hives to be used and some other necessary equipment. The bees are as contented in an old box or tub as in the best modern hive, but for economical production of honey a carefully made hive is essential. Below are described two of the most popular kinds.

THE STANDARD OR LANGSTROTH HIVE.

This is the regular standard hive used by nearly all practical beekeepers and shown in figure 6. A more thorough description is given in supply catalogs. The hive consists of a bottom board, the brood chamber or living quarters, which is a box containing either eight or ten movable frames, and a cover. This hive, less a few minor improvements, was invented in 1851 by the Rev. L. L. Langstroth and is sometimes called the Langstroth hive. It was his knowledge of the peculiarities of the bee that enabled him to invent a hive that revolutionized beekeeping. All other movable frame hives are but modifications of this, though some of them are but poor substitutes.

It is usually better for the beekeeper to buy his hives in the flat, nailing them together himself, rather than to try to make them, especially if he values his time at anything. Factory-made hives are made with great accuracy.

This hive being adopted as the standard, it is very reasonable to suppose that it combines within itself more good qualities than any other and should therefore have the preference.

THE SUPER.

Above this standard hive and beneath the cover, is placed a shallow box or frame holding the comb-honey sections and called a "super." The super is shown in figures 7–10, and is the storeroom of the hive, in which the bees place their surplus honey. Often several supers are placed on one hive.

These supers may be used for either comb or extracted honey, and are each fitted out differently with inside fixtures, the ex-

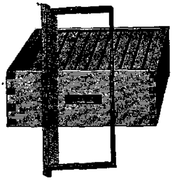


Figure 8. Shallow extracting super. (After the A. I. Root Co.)

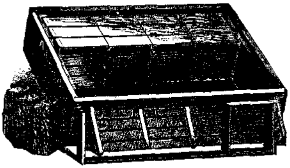


Figure 9. Plain section super. (After the A. I. Root Co.)

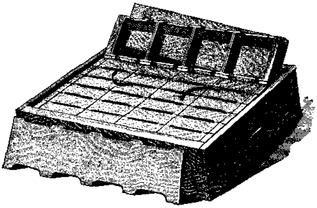


Figure 10. Slotted section super. (After the A. I. Root Co.)

tracting supers having frames similar to those of the brood chamber, only much shallower. These are also used in the sectional brood chamber hive described on page 429. The section box super is provided with section holders or forms to hold the delicate section boxes.

The slotted section super is the oldest and there are probably more of them in use at present among beekeepers than any other, but they are slowly being discarded for those of later design. One important point in the construction of a super is simplicity. The more parts there are, the more time it takes to keep them cleaned of propolis, a gummy substance that the bees use to cover cracks in the hive. This must all be scraped off each time a super is

emptied so that the parts will go together again. The super most highly recommended hy the writer is what is known as the N. section frame super, shown in figure 7.

This super, as the name implies, is fitted with eight section frames holding four section hoxes each with the ten-frame hive, or seven with the eight-frame hive. The frames are separated by fences, as is shown in the illustration above. These frames not only serve to hold the section boxes square, but by covering them completely protect them from stains and propolis that are always present when the open top styles are used.

THE FRAME.

The frame most commonly used with these hives is what is known as the Hoffman self-spacing, shown in figure 11. This is built in two sizes, one being 9 1-8 inches deep for the regular hive; the other 5 3-8 inches deep for the shallow hive or super. These are suspended separately so that the beekeeper may be able to take a hive of bees entirely apart if he desires. The person who has a modern hive and does not avail himself of the advantages it permits may as well go back to the old box hive of his grandfather.

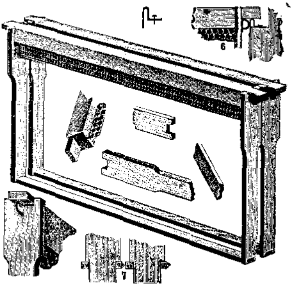


Figure 11. The Hoffman frame. (After the A. I. Root Co.)

THE SECTIONAL BROOD CHAMBER HIVE.

Another hive highly recommended by the author, especially in the production of comb honey, is what is called the sectional brood chamber hive, shown in figure 12. This is built up with two or more units of extracting supers, such as are used with the Standard in the production of liquid honey. This hive is especially adapted to localities like our own, where the honey flow is of short duration

and rapid work in the super is required. It also makes an ideal brood chamber for wintering. The opening between the two sets of frames forms a passage for the bees to pass, during extreme cold weather, to get to fresh winter stores, without going over, under, or around the combs through the cold extremities of the hive; supers and brood chamber units are interchangeable; colonies are easier and better kept under control during the swarming season; it is easy to make increase when desired simply by removing one unit and supplying it with a queen; and a strong colony is always ready for the super when desired by simply removing all but one unit of the brood chamber. Beekeepers often ask, "How can I get my bees to work in the super?" The sectional hive solves the problem. It puts the honey in the super. Yes, all the honey.

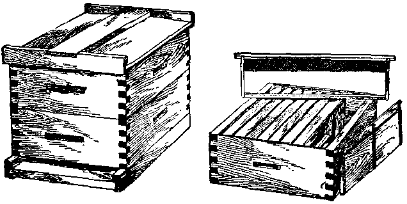


Figure 12. Sectional brood chamber hive. (After W. T. Falconer Mfg. Co.)

A queen excluder (see figure 13) should always be used between the brood chamber and super of this hive; otherwise the queen in her restricted quarters would go above to lay and it is desirable to keep brood and surplus honey separated. This hive might be termed a specialist's hive but it can be easily managed by an amateur. Both of the above hives are built in two sizes, for eight or ten frames. The ten-frame size is the one most commonly used by experienced beekeepers so that it is safe to decide that this is the best adapted for all purposes.

The beginner will make no mistake in selecting either of the hives or supers described above. The amateur who keeps only a few hives will readily decide to work for comb honey, because this will not require an expensive extractor and nice white combs of section honey will appeal to him. For this purpose the sectional

hive is worthy of consideration. All hives or parts should be alike so as to be interchangeable. There probably is no worse nuisance in an apiary than several different styles and shapes of hives and supers.

Smokers.

The smoker (see figure 14) is indispensable while handling bees. It is made of tin or copper and is provided with a bellows to drive the smoke and keep the fire going. Old cotton rags, waste or rotten wood are used for fuel. Blow a little smoke in at the entrance before opening the hive. Give the bees a little more while uncovering the frames; if very cross, repeat the dose, until they yield; then they may be handled safely. Handle them gently, avoiding all quick motions.

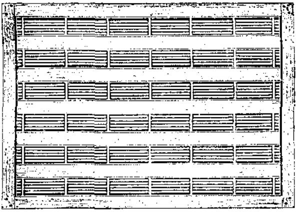


Figure 13. Wood-and-wire queen-excluding board, with seven-wire strips. (After the A. I. Root Co.)

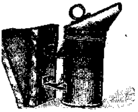


Figure 14. Junior moker. (After the . I. Root Co.)

Figure 15. Bee-glove with fingers. (After the A. I. Root Co.)

Figure 16. Th Alexander bee veil (After the A. I Root Co.)

Veils.

In addition to the smoker, a veil is necessary for the beginner, and possibly gloves for the hands. It is foolish for the novice to undertake to handle bees without proper protection. One type of veil is shown in figure 16 and a glove in figure 15.

Hive Tool.

Some kind of a hive tool is a necessity. The one illustrated in figure 17 is excellent, though a screwdriver will do.

Comb Foundation.

The comb foundation is a thin sheet of pure beeswax, shown in figure 18, embossed to imitate the base or septum of the natural built comb. The use of this is almost indispensable in securing straight worker brood combs. For economy some beekeepers use only starters, which are narrow strips about one inch wide. This results in the building by the bees of a considerable amount of undesirable drone comb. Later, when this is occupied by the queen, sometimes multitudes of useless drones emerge, which are consumers instead of producers. Three workers or producers can be hatched from the same comb surface that is occupied by two drone cells; therefore it is evident that the full sheets of foundation are cheapest in the end. The use of full sheets is further demonstrated when it is remembered that it takes from fifteen to twenty pounds of honey to produce one pound of wax, and the comb must be built before it can be used for storing honey or brood.

Figure 17. Nickeled-steel hive-tool. (After the A. I. Root Co.)

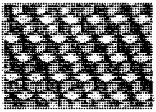


Figure 18. Comb foundation. (After the A. I. Root Co.)

Stocking with Bees.

After getting the hive ready, the next thing is to have it stocked with bees. As a general rule it is best, if possible, to buy good-sized first swarms as they issue during early May. These can usually be procured locally for about three dollars. One great advantage in securing bees in this way is the freedom of any danger of brood diseases which might be found in a colony with combs. Brood diseases are dangerous for the veteran beekeeper but much more so for the beginner. Such a colony hived in a single-story standard hive will soon fill it with honey and brood and a super should be furnished so that all surplus may be stored; likewise with the sectional hive, a single unit is used and a super of section boxes is put on immediately with the excluder between. It is possible and even probable that this may be followed with another one week later, if the honey flow continues. A second unit of brood chamber, however, should be added in sufficient time for the bees to stock it up for winter.

If swarms cannot be obtained in this way it is best to purchase from some reliable dealer. These may be obtained either in bulk, in nucleus, or in full colonies. Full colonies will sometimes produce enough the first season to pay for themselves, so that this usually is a very satisfactory way to buy, and the purchaser will have gentle, blooded stock to start with.

THE COLONY.

Every normal colony of bees in prosperous times is composed of three varieties of bees: the queen, or, more correctly speaking, the mother bee, that lays all the eggs (often as many as three thousand a day during the busy season); forty or fifty thousand

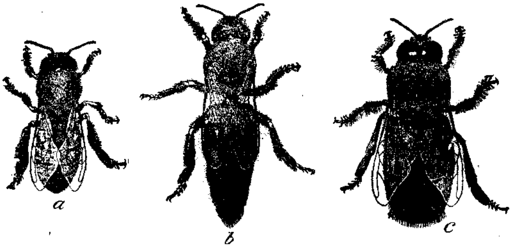


Figure 19. The honey bee: *a*, worker; *b*, queen; *c*, drone. Twice natural size. (After Phillips, Bureau of Entomology, U. S. Department of Agriculture.)

workers or undeveloped females; and a few hundred drones or male bees. The queen is the important factor in the success of the colony. Ancient writers called her the "King," and it was only within a few years that the error was discovered. Some queens are so prolific that the ordinary hive is too small to accommodate them, keeping it overflowing with bees and activity, while others are so inferior that their colonies make only a sickly effort to exist. The drone, queen and worker are shown in figure 19.

As has been mentioned, the combs are composed of two different sized cells. Eggs laid in the larger or drone cells always mature drones, while those laid in the smaller ones mature workers. The

queen cell is simply an elongated worker cell, resembling a peanut, drawn out over the comb. In case the colony needs a queen, any worker egg laid or placed in one of these cells will hatch into a larva, which will be lavishly fed with a thick, milky fluid and mature a queen. The queen usually passes the time of her greatest usefulness in her second year. For this reason a good many progressive beekeepers practice requeening at this time. Eggs are shown on plate XXXVI, c, and drone, queen and worker cells on plate XXXV, b.

Workers.

By far the most numerous bees in the hive are the workers. They are also the smallest, measuring only about one-half inch in length. Except laying the eggs, they do all the work about the hive—gathering the honey and pollen; building the combs; feeding and taking care of the brood; cleaning the hive, sealing all cracks and doing all other labor required. The life of the workers during the busy season is only about six weeks, in which time they wear out their wings flying against the wind or through the grass in the fields in search of food. For this reason grass should always be kept down in front of the hive entrance.

Drones.

The drones are the non-producers of the hive and live on the toil of the workers. They have no means of producing honey or secreting wax or doing even the work necessary for their own support. They are longer than the workers, shorter than the queen, but thicker and clumsier than either. Their wings reach to the tip of their body; and when they are on the wing they make much more noise. Their sole object is to mate with the young queens, which always happens on the wing. After the mating the drone dies immediately.

Races of Bees.

The black or German bee was the first brought to this country, some say by the Pilgrims; others, by way of Florida. These are a very hardy race and good honey gatherers, more especially adapted to the production of comb honey, but their irritable temper and inability to resist disease have brought them into disfavor.

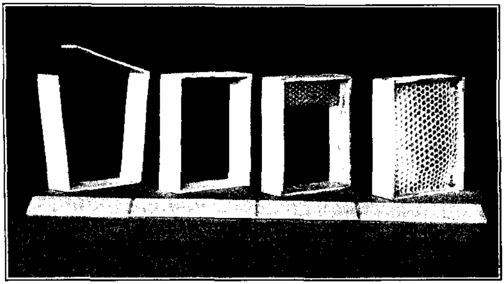
Their cousins, the Banats, Carniolans and Caucasians, three other dark races, are gentle and good honey producers if they can

a. Mating and queen rearing apiary of A. W. Yates, Hartford.

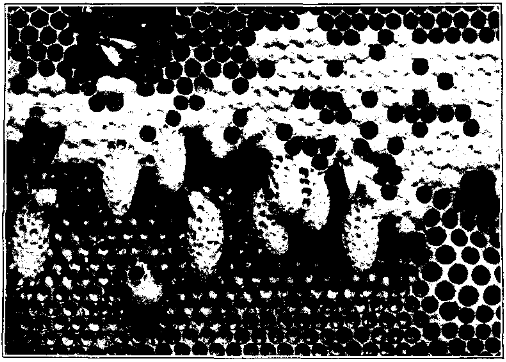
b. View of apiary at Station farm, Mt. Carmel.

PLATE XXXIV.

A standard hive opened showing brood frames: Mr. L. C. Root, Stamford, a veteran Connecticut beekeeper. (After Dr. E. F. Bigelow, Arcadia, Sound Beach, Conn.)

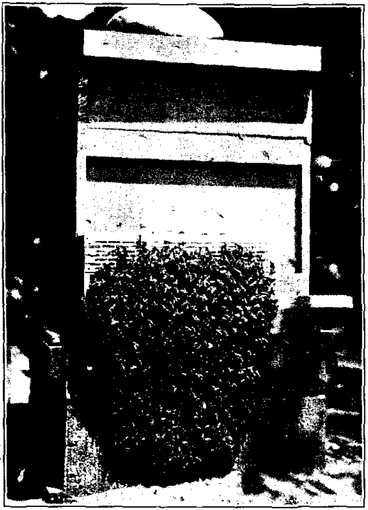


a. Section frames as used in the supers: in the flat, bent together, with foundation starter, and with drawn comb ready to receive the honey.



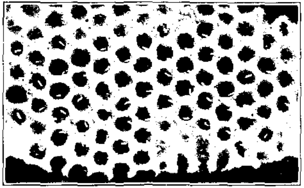
b. Close view of brood comb, showing open and capped cells: the large peanut-shaped cells are queen cells; the larger open cells near lower right hand corner are drone cells; others are worker cells. (After Dr. E. F. Bigelow, Arcadia, Sound Beach, Conn.)

PLATE XXXVI



a. A swarm just hived.

b. A frame of American foul brood.



c. View through the glass of an observation hive, showing eggs in cells.

be kept from swarming, but this is almost impossible. The Cyprians are energetic workers but also have bad tempers, which bar them from most apiaries.

The Italians, introduced into this country in the sixties, are the most popular among good beekeepers. They are good workers, and, as a rule, are as gentle to handle as any of the other races named. These qualities, together with their rich, golden color, and their ability to withstand some of the worst ravages of foul brood, make them the favorites of our beekeepers.

Location.

The needs of the bees are seldom considered in selecting a location. It is best to choose a sheltered spot, protected as much as possible from prevailing winds. The south side of a hedge, a high board fence or building, or a clearing in the woods, is good. Look out for air currents, such as circulate between two buildings. Have the hives face the south as near as convenient.

Swarm Control.

It requires a large force of bees in each hive to secure a crop of honey. The larger the force when the flow arrives, the better. The beekeeper with one hundred weak colonies would get scarcely any surplus, while the one with only twenty-five or fifty colonies of good strength would obtain good results. This crowded condition, however, is one of the primary causes of swarming, and it is advisable, as far as possible, to have no swarming during the honey flow. Some of the precautions taken for its prevention are the introduction of young queens some time previously; giving plenty of room by adding a super, and when this is partially full, if the prospects look good for the continuance of the flow, inserting another beneath the first; ventilating by giving full, wide entrance, or if the nights are very warm, raising the hive an inch from the bottom board. These methods, while precautionary to discourage swarming, are not preventive and it is advisable to examine every colony occasionally for symptoms, and if at any time it is found that queen cells are started, they should be cut out and a super of extracting combs given without the excluder. A week later, if no cells are started, this can be exchanged for a comb honey super. Should cells be started, however, remove the super, taking the

queen with it, and exchange places with the brood chamber, using this as a brood chamber. Put on a super of section boxes immediately and close the hive. A portion of the bees in the old brood chamber should then be shaken in front of the new hive, leaving only enough to properly take care of the brood, or, if no increase is desired, all should be shaken out and the brood disposed of among weak colonies. This old chamber of brood and some bees having queen cells under way will soon mature a queen and later become as good as any colony.

Comb Honey.

Much more labor and skill is required in the production of comb honey than in extracted honey. In a great many locations some form of contraction is necessary to secure good work in the super. This is true of our own locality and sometimes it is almost impossible to get the bees to go to work in the supers. To remove some of the frames and replace them with wooden dummies invariably results in poor filling of the outside sections and getting them completed with the rest. For this reason all deep frame hives, if not failures, at least are clumsy. It will be seen, then, that it is better to contract from the top, retaining in this way the whole supering surface. With the sectional hive, removing all but one unit reduces the capacity of the brood chamber to the desired amount. This the queen will keep filled with brood, forcing the honey into the super. This single unit, holding the equivalent of about six and one quarter regular frames, is sufficient to maintain the strength of the colony during the main honey flow, after which another unit should be given for the bees to build up for winter. Obviously it takes but a moment's time with this hive to provide a very large brood nest or to contract to a very small one. Units should never be taken away, however, without giving their equivalent in supers, unless a swarm is desired.

Usually during fruit bloom most colonies will require more room. One unit of brood chamber filled with full sheets of foundation is given. This will be drawn out and occupied with honey and brood at the beginning of the clover flow. This is the unit, with its bright, new combs, that should be used when the brood chamber is reduced to one unit. Fancy, white comb honey would become more or less travel-stained if old brood combs were used

here. The excluder and super of section boxes are added and when this is about half filled another is inserted between. More are added as long as there is a prospect of their being finished, so that sometimes there are four or five on at once. Finished section honey should be removed from the bees as soon as completed. It sometimes takes but a few days to become soiled.

As stated previously, with the regular depth frame, bees are sometimes slow to enter the super, because of insufficient numbers or because of three or four inches of capped honey along the top bar of the brood frame, or because the honey flow is not plentiful enough. One or two sections of foundation should be removed and replaced with some that are partly drawn. These are called "Bait sections" and will generally bring about the desired result, and when the bees have once commenced to work in them there will be no further trouble.

Extracted Honey.

To produce extracted honey also requires a large force of bees in each hive. Weak colonies should be built up or united in advance so that all will be at full strength when the flow arrives. Either of the above hives can be used with supers the same size as the brood chambers or with shallow extracting supers. The shallow ones will probably be found the most satisfactory. After the combs are built, nine frames should be used in a ten-frame, or seven in an eight-frame hive. This results in thick, fat combs that are more easily uncapped. The excluder should be used.

When to Put on Supers.

To produce fancy comb honey, full sheets of thin or extra thin foundation should be used in the section boxes. These should be prepared and the supers ready in advance so that there will be no delay when they are needed. This will be about the middle of May if the season should be early and plenty of fruit bloom near by, or the first to the middle of June for clover. A good rule is to put on supers, either for comb or extracted honey when the combs begin to show white along the top bar and the brood nest appears crowded with bees.

THE EXTRACTOR.

This is a machine with a revolving frame inside, used to remove the honey from the combs, and shown in figure 20. After the honey has thus been removed the combs are returned to the bees to be refilled. It is obvious that this is a great saving to the bees both in time and labor, which is very important during a rapid honey flow, and is the reason why liquid or extracted honey, as it is called, can be bought so much cheaper. An extractor is a good investment for a beekeeper with five or more colonies of bees. In setting the extractor it should be securely fastened in place and raised enough from the floor so that a pail will go under the gate.

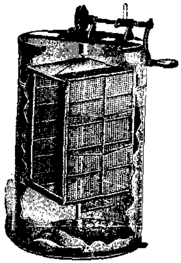


Figure 20. Novice non-reversible extractor. (After the A. I. Root Co.)

When the frames of honey are removed from the hive, they are taken into the extracting room, or some room that bees cannot enter and the cappings are cut off with a sharp knife (See figure 21). They are then put into the extractor, and after the honey has been removed from one side they are turned around and it is taken from the other.

Figure 21. Improved Bingham honey-knife. (After the A. I. Root Co.)

After the combs have been emptied, if the flow is over they should be stacked over one or more colonies, to be cleaned of what honey remains. This should be done at night so that they will be finished before daylight—when there is danger of robbers. At the end of the season all extracting combs should be put away secure from rats and mice. One mouse alone will do an immense amount of damage if allowed access to them. For protection from the wax moth, which sometimes makes its appearance, a few camphor balls can be used in each stack of combs.

CARE OF EXTRACTED HONEY.

Liquid honey as it is removed from the extractor should be strained into a deep tank and allowed to stand and settle for a

day or two. This allows small particles of wax to rise to the surface to be skimmed off. It is then bottled or put into cans as desired.

Honey and Its Uses.

Honey is made from a very thin nectar gathered from the flowers by the bees, and carried into their hives. It is so thin that sometimes it takes over two pounds of nectar to make one pound of honey. Different flowers produce different flavors and colors, as, for example, the very light and mild-flavored honey from linden or sweet clover, and the dark and strong-flavored honey from buckwheat.

The chemical analysis of honey shows that it is practically all invert sugar, though small proportions of fruit sugar and sucrose are present. Granulation occurs quickly in some honeys and takes place only after long keeping in others. Nearly all honeys granulate at the approach of cold weather and granulation is an indication of purity rather than of adulteration.

Honey is an excellent food, being almost pre-digested, and is especially recommended for children, invalids and consumptives. The common belief that honey, unlike sugar, can be used safely by diabetics seems not to be supported by facts.

Bakers have found that cookies and cakes, when sweetened with honey, will keep moist and palatable for a long time, and as it is in a sense a preservative, they will not mold. For this reason it is used in canning fruits, immense quantities of the cheaper grades being employed. It is used extensively by biscuit manufacturers and confectioners, one firm alone buying hundreds of tons each year.

For cooking recipes requiring honey, the reader should consult Farmers' Bulletin No. 653, U. S. Department of Agriculture, Washington, D. C.

Honey Plants.

Some of the principal honey and pollen plants of Connecticut, mentioned in about the order in which they commence to yield, are as follows:

Skunk cabbage, willow and elm trees, March and April. These are valuable for early pollen but furnish little nectar.

Maples; April, pollen and nectar.

Dandelion; May 10, pollen and some nectar.

Fruit bloom; May 15, pollen and nectar; when weather conditions are favorable, sometimes surplus honey.

Wild raspberry; June, pollen; nectar makes exceptionally fine table honey and usually yields plentifully.

Locust; May and June; some kinds yield heavily; honey light and of good flavor.

Clover; June 15. The clovers are the most important class of honey plants and include the common white, red, alsike, crimson and sweet clover. Alfalfa, although of the same family, secretes no nectar in this State. White and alsike are by far the most important and in some years produce large quantities of the finest table honey, which is recognized by its light golden color and delicate flavor.

Sweet clover; June until frost. This plant is not duly appreciated by our farmers, so is not sufficiently abundant in Connecticut to be an important honey plant. The honey is light colored, with a pleasant, spicy flavor, making it a delicious table honey. This plant is an exceptionally good forage plant, usually found growing in waste places or where the soil is too poor for other crops. Like the other clovers it requires lime for abundant growth, and when grown under favorable conditions can be cut two or three times a season. The hay is of fine quality, and is relished by horses and cattle.

Red clover; June. Secretes nectar abundantly, but on account of its corolla tubes being too long for honey bees it is more of a bumblebee plant. However, in times of drouth or in case of second growth when the tubes are shorter, it is sometimes worked extensively by honey bees.

Linden or basswood; July. This tree is seldom sufficiently abundant to become an important source of honey. The honey is very light and of fine flavor.

Sumac; July. Some kinds yield nectar freely. The honey is light and of fine flavor.

Goldenrod; September to frost. Honey is light, of good flavor when well ripened.

Wild aster; October till frost. Honey light and of good flavor, but granulates quickly.

Diseases of Bees.

Bees, like all other living things, are subject to diseases, the most common of which in Connecticut are the contagious bacterial brood diseases known as American and European foul brood. The latter is by far the most prevalent, having been found in every county and in some cases wiping out whole apiaries. These diseases, however, if taken in time, can be controlled, but if neglected are sure to cause loss and be a source of infection to surrounding apiaries. For this reason it is imperative that beekeepers should become acquainted with the appearance of these diseases and the methods of treatment so as to handle them intelligently. European foul brood, although much more contagious and rapid in spreading, responds better to treatment than the American foul brood. Dr. Phillips of the Bureau of Entomology at Washington describes the two diseases as follows:

"The presence of a particular disease in a colony of bees can be ascertained most reliably by a bacteriological examination, since the symptoms are somewhat variable. It is possible, however, to describe the usual manifestations of the diseases, and the usual differences, so that the beekeeper can in most cases tell which disease is present.

American Foul Brood.

"American foul brood is frequently called simply 'foul brood.' It usually shows itself in the larva just about the time that the larva fills the cell and after it has ceased feeding and has begun pupation. At this time it is sealed over in the comb. The first indication of the infection is a slight brownish discoloration and the loss of the well-rounded appearance of the normal larva. At this stage the disease is not usually recognized by the beekeeper. The larva gradually sinks down in the cell and becomes darker in color and the posterior end lies against the bottom of the cell. Frequently the segmentation of the larva is clearly marked. By the time it has partially dried down and has become quite dark brown (coffee colored) the most typical characteristic of this disease manifests itself. If a match stick or toothpick is inserted into the decaying mass and withdrawn the larval remains adhere to it and are drawn out in a thread which sometimes extends for several inches before breaking. This ropiness is the chief characteristic used by the beekeeper in diagnosing this disease. The larva continues to dry down and gradually loses its ropiness until it finally becomes merely a scale on the lower side wall and base of the cell. The scale formed by the dried-down larva adheres tightly to the cell and can be removed with difficulty from the cell wall. The scales can best be observed when the comb is held with the top inclined toward the observer so that a bright light strikes the lower side wall. A very characteristic

and usually penetrating odor is often noticeable in the decaying larvae. This can perhaps best be likened to the odor of heated glue.

"The majority of the larvae which die of this disease are attacked after being sealed in the cells. The cappings are often entirely removed by the bees, but when they are left they usually become sunken and frequently perforated. As the healthy brood emerges the comb shows the scattered sunken cappings covering dead larvae, giving it a characteristic appearance.

"Pupae also may die of this disease, in which case they, too, dry down, become ropy, and have the characteristic odor and color. The tongue frequently adheres to the upper side wall and often remains there even

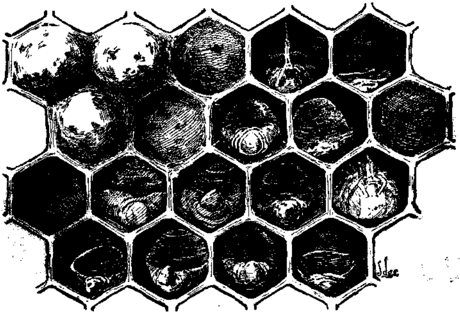


Figure 22. American foul brood: note the normal sealed cells; the sunken cappings, some showing perforations; the larvae and pupae affected by disease; the scales formed from dried-down larvae. Three times natural size. (After Phillips, Bureau of Entomology, U. S. Department of Agriculture.)

after the pupa has dried down to a scale. Younger unsealed larvae are sometimes affected. Usually the disease attacks only worker brood, but occasional cases are found in which queen and drone brood are diseased. It is not certain that race of bees, season, or climate have any affect on the virulence of this disease, except that in warmer climates, where the breeding season is prolonged, the rapidity of devastation is more marked. See figure 22.

European Foul Brood.

"European foul brood was formerly called 'black brood' or 'New York bee disease.' The name 'black brood' was a poor one, for the color of the dead brood is rarely black or even very dark brown. European foul brood usually attacks the larva at an earlier stage of its development than

American foul brood and while it is still curled up at the base of the cell. A small percentage of larvae dies after capping, but sometimes quite young larvae are attacked. Sunken and perforated cappings are sometimes observed just as in American foul brood. The earliest indication of the disease is a slight yellow or gray discoloration and uneasy movement of the larva in the cell. The larva loses its well-rounded, opaque appearance and becomes slightly translucent, so that the tracheae may become prominent, giving the larvae a clearly segmented appearance. The larva is usually flattened against the base of the cell, but may turn so that the ends of the larva are to the rear of the cell, or may fall away from the base. Later the color changes to a decided yellow or gray and the translucency is lost. The yellow color may be taken as the chief characteristic of this

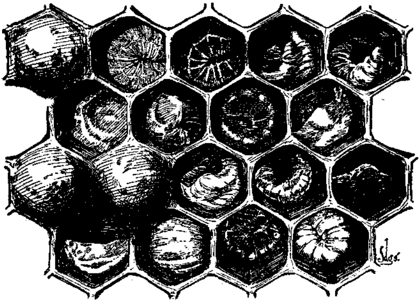


Figure 23. European foul brood: note the normal sealed cells; the larvae affected by disease; the normal larva at age attacked by disease; the dried-down larvae or scales. Three times natural size. (After Phillips, Bureau of Entomology, U. S. Department of Agriculture.)

disease. The dead larva appears as a moist, somewhat collapsed mass, giving the appearance of being melted. When the remains have become almost dry, the tracheae sometimes become conspicuous again, this time by retaining their shape, while the rest of the body content dries around them. Finally all that is left of the larva is a grayish-brown scale against the base of the cell, or a shapeless mass on the lower side wall if the larva did not retain its normal position. Very few scales are black. The scales are not adhesive, but are easily removed, and the bees carry out a great many in their efforts to clean house.

"Decaying larvae which have died of this disease are usually not ropy as in American foul brood, but a slight ropiness is sometimes observed. There is usually little odor in European foul brood, but sometimes a sour

odor is present, which reminds one of yeast fermentation. This disease attacks drone and queen larvae almost as quickly as those of the workers.

"European foul brood is more destructive during the spring and early summer than at other times, often entirely disappearing during late summer and autumn, or during a heavy honey flow. *Italian bees seem to be better able to resist the ravages of this disease than any other race.* The disease at times spreads with startling rapidity and is most destructive. Where it is prevalent a considerably larger percentage of colonies is affected than is usual for American foul brood. This disease is very variable in its symptoms and other manifestations and is often a puzzle to the beekeeper." See figure 23.

To the ordinary beekeeper the two diseases appear very much alike. "The sunken and perforated cappings, the reduction of the larva to a stringy, brown mass, the foul odor, and the dwindling of the colony, are the most noticeable indications of the foul brood diseases."

How Foul Brood Diseases are Spread.

Some of the means of spreading the infection are as follows:

By the bees:

1. Diseased bees entering wrong hives.
2. Robbing diseased colonies.
3. Eating honey that is infected.

By the owner:

4. Shifting combs from diseased colonies to healthy ones.
5. Using second-hand hives that have contained diseased colonies.
6. Promiscuous handling of healthy and diseased colonies without disinfecting hands and tools.
7. Exchanging places of colonies in diseased apiaries.

Treatment.

As it has been found that Italian bees are more immune to, or at least better able to resist the ravages of, European Foul Brood than other races, it is strongly recommended that apiaries be requeened with young Italian queens of good stock in either of the treatments given below. In the case of all weak colonies, or those showing 25 per cent. or more of diseased brood, it is best to shake the bees if in frame hives, or drum them out if in box hives, into new or disinfected hives containing full sheets of foundation. Good results are sometimes obtained where the colony is VERY

STRONG and the infection is SLIGHT, or less than above stated, by removing the old queen and introducing a young one of good Italian stock ten days later. This results in the cessation of egg-laying for several days, allowing the colony a chance to clean up the decayed matter. The dequeening method should not be used in the treatment of American Foul Brood, which can best be cured only by the shaking method. When treating by the shaking method, it is best to select a time when there is *some honey coming in*, as there is less danger of robbing and the colony will require no further feeding.

If, however, it is decided to treat immediately, and there is no honey coming in, it should be done towards night when few bees are flying, so as to avoid infecting other colonies. For this reason care should be taken not to spill or drop any honey where bees will have access to it. If no honey is coming in, feed a pint of sugar sirup each night for a week or until the bees are nicely started. Never use honey for feeding if it can be avoided.

Disinfection.

All tools, as well as the hands, should be washed thoroughly and the inside of the hive scorched with fire. A plumber's torch is best for this purpose but the hive can be moistened with kerosene oil and lighted, and when sufficiently scorched the fire can be extinguished with a blanket thrown over the hive. The combs should be melted into wax and the refuse burned or buried, and not left where bees can visit it.

Apiary Inspection in Connecticut.

Since 1909 apiaries in Connecticut have been inspected for foul brood diseases, as provided by Statute, the supervision of the work being in charge of the State Entomologist. Two inspectors are employed on a *per diem* basis, as follows: Mr. H. W. Coley, Westport, Inspector for Fairfield, New Haven, Middlesex and New London Counties; Mr. A. W. Yates, Hartford, Inspector for Litchfield, Hartford, Tolland and Windham Counties. Permanent records of these inspections are kept in the office of the State Entomologist at New Haven, and accounts of each season's work have been published in the Reports of this Station as follows:

1910, page 669; 1911, page 275; 1912, page 223; 1913, page 195; 1914, page 126; 1915, page 95; 1916, page 78; 1917, page 242.

Applications for inspection, or for advice about handling bees, may be made to either of the inspectors named above, or to W. E. Britton, State Entomologist, Agricultural Experiment Station, New Haven, Conn.

Publications on Beekeeping.

The following publications will prove useful to those who desire further information on apiculture.

BOOKS.

How to Keep Bees, by Anna Botsford Comstock. Doubleday, Page & Co., Garden City, N. Y., 1905. $1.00.

Beekeeping, by E. F. Phillips. The MacMillan Co., New York, N. Y., 1915. $2.00.

Productive Bee-Keeping, by Frank C. Pellett, J. B. Lippincott Co., Philadelphia, Pa., 1916. $1.50.

A B C and X Y Z of Bee Culture, by A. I. and E. R. Root. The A. I. Root Co., Medina, O., Revised Edition, 1913, $2.50.

BULLETINS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

The Honey Bee, by Frank Benton, Bulletin No. 1, New Series, Division of Entomology, 1896.

The Rearing of Queen Bees, by E. F. Phillips, Bulletin No. 55, Bureau of Entomology, 1905.

The Production and Care of Extracted Honey (Part I); Wax Moths and American Foul Brood (Part II) by E. F. Phillips, Bulletin No. 75, Bureau of Entomology, 1907.

The Treatment of Bee Diseases, by E. F. Phillips. Farmers' Bulletin No. 442, 1911.

Bees, by E. F. Phillips. Farmers' Bulletin No. 447, 1911.

Comb Honey, by Geo. S. Demuth, Farmers' Bulletin, No. 503, 1912.

Honey and Its Uses in the Home, by Caroline L. Hunt and Helen W. Atwater. Farmers' Bulletin No. 653, 1915.

STATE BULLETINS.

The Honey Bee, by Wheeler D. Wright, Bulletin No. 49, New York State Department of Agriculture, Albany, N. Y., 1913.

Beekeeping in Massachusetts, by Burton N. Gates, Bulletin No. 129, Massachusetts Agricultural Experiment Station, Amherst, Mass., 1909.

Some of the Essentials of Beekeeping, by Burton N. Gates, Bulletin No. 5, Massachusetts State Board of Agriculture, Boston, Mass., 1912.

The Honey Bee, A Guide to Apiculture in Canada, by C. Gordon Hewitt, Bulletin No. 69, Department of Agriculture, Ottawa, Canada.

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 206 FEBRUARY, 1918

Being the Report on Commercial Feeding Stuffs 1917

By E. M. BAILEY

INDEX

AND

Reports of Board of Control and Treasurer

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to others as far as the editions permit.

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Commercial Feeding Stuffs.

By E. M. Bailey*

Under the Connecticut statutes the term "concentrated commercial feeding stuff" covers practically all feeds excepting hay and straw, whole seeds, unmixed meal made directly from any of the cereals or from buckwheat, and feed ground from whole grain and sold directly from manufacturer to consumer.

Section 4592 requires that every lot or parcel of concentrated commercial feeding stuff shall hear a statement giving the name and address of the manufacturer or importer, the number of net pounds in the package, the name of the article, and the percentages of protein and fat contained in it. The law forbids the use of any metal in affixing tags.

No registration of feeds or payment of analysis or license fees is required.

The penalty for violation of the statute is not more than $100 fine for the first offense and not more than $200 for each subsequent offense.

The law authorizes this station to take samples from any manufacturer or dealer, in a prescribed manner, and requires the station to analyze annually at least one sample of each brand which it has collected, and to publish these analyses "together with such additional information in relation to the character, composition and use thereof as may be of importance."

INSPECTION OF 1917.

One hundred and two samples of feeds were collected by our agent, Mr. Churchill, during the months of November and

* With the assistance of Messrs. C. E. Shepard, M. A. D'Esopo and H. D. Edmund, Analysts.

December, 1917, and January, 1918. These samples are classified as follows:

Cottonseed Meal	11	Hominy Feed	5
Cottonseed Feed	1	Brewers' Grains	2
Linseed Meal	4	Distillers' Grains	2
Wheat Bran	6	Dried Beet Pulp	2
Mixed Feed	10	Horse, Dairy and Stock Feed	35
Wheat Middlings	6	Cocoa Shell Meal	1
Rye Feed	3	Poultry Feed	10
Rye Middlings	1		
Corn Oil Cake Meal	1		
Gluten Feed	2	Total	102

Miscellaneous feeds, fifty-two in number, have been sent in by private individuals and by the Dairy Commissioner.

One hundred and twenty-one complete fodder analyses were made in connection with field experiments of the Storrs Station.

One hundred and forty-three such analyses in connection with field experiments of this Station were also made.

Seven hundred samples of shelled corn were examined for nitrogen or moisture or both. These are in connection with plant breeding experiments.

A total of 1,118 samples of fodder materials have had complete or partial analyses.

Only the regular fodder inspection and miscellaneous feeds sent by private individuals will be discussed here. Other results are connected with investigations which will be discussed elsewhere.

THE ROLE OF THE NUTRIENTS.

The law of this State requires a statement of the amount of protein and fat only in any feed, but for the intelligent preparation of a ration other nutrient constituents should be known. Numerous authoritative works* on the nutrition of animals discuss the

* **Henry and Morrison,** Feeds and Feeding. Henry and Morrison, Madison, Wis. **Jordan, W. H.,** The Feeding of Animals. The MacMillan Co., New York. **Armsby, H. P.,** The Principles of Animal Nutrition. John Wiley & Son, New York.

functions of the several constituents at much length, but it will not be amiss to briefly restate here the part played by these constituents in the digestive process.

Water. Air dry feeding stuffs, whether concentrates or roughage, still contain some moisture which cannot be seen or felt. The amount of such moisture averages not far from ten or twelve per cent. While not a nutrient in the ordinary sense, water is essential to the animal, but since it is obtained in abundance from sources other than the feed, its presence therein is not of importance. Excessive amounts, however, jeopardize the keeping qualities of a feed and automatically reduce the percentage of the more desirable ingredients.

Ash. The mineral constituents of feeds are contained in the ash. Their importance is far greater than has been generally supposed and can be appreciated from the fact that animals fed on rations deprived so far as possible of all ash constituents, generally die sooner than animals given no food at all. That lime, iron, phosphorus, potassium, sodium, chlorine and other mineral substances, all of which are contained in the ash of vegetable materials, are essential to the animal body, is shown by the conspicuous presence of one or more of them in all the vital tissues and secretions. Just how they act is not completely understood, but one of their functions is undoubtedly to stimulate those cell activities (enzymic processes) which are at the foundation of both animal and vegetable life.

Protein. This is the name of a group of nitrogen-containing substances essential to the life of the animal body. They repair body waste, build up new body tissue, and, to a lesser extent, furnish heat and energy. It was long supposed that all the group of proteins could perform all these functions. But investigations of recent years, particularly those which have been carried on in the research laboratory of this Station, have shown that such is not the case; that while one protein can both repair and build, another can repair only. The one not only suffices to maintain the body against its own wear and tear, but causes it to grow and develop naturally; the other suffices only to prevent decline. Hence the important distinction has been made between complete and incomplete proteins. This is enough to suggest that, in addition to the standard of digestibility by which we now

differentiate between proteins, we shall eventually judge them by the more critical standard of specific service rendered. It further suggests the wisdom, not only of supplying a sufficient quota of protein in the ration of an animal, but of supplying it from different sources so that those elements which are deficient or lacking in one may be supplied by another. In other words, a mixed ration is as desirable for the lower animals as for human beings.

Crude Fibre. By this term is meant the coarser and more woody tissue characteristic of all forms of roughage and present on the outer coats of cereal grains. Such material is in part digested by ruminants but its chief value lies in its mechanical effect in the intestinal tract.

Nitrogen-free Extract. Here are included those substances termed carbohydrates which embrace nutrients of the starch and sugar types. Their principal part in nutrition is to supply heat and energy, but they have also the power of sparing protein, by which is meant that when fed together with protein they reduce the amount of the latter food required. An excess of these foods over the immediate needs of the body can be transformed into fat and stored in the body tissue.

Ether Extract (Crude Fat). Fats, like the carbohydrates furnish energy to the body and like them also, but to a lesser extent, spare protein. As energy producers their value is 2.25 times greater than that of either carbohydrate or protein. This ether-soluble material is in all cases crude fat, by which we understand that non-fatty substances like chlorophyll and coloring matter may be included therein.

Table 1 shows the digestion coefficients, or percentages of the food elements of the more commonly used feeds which are digestible by neat cattle (Feeds and Feeding, by Henry and Morrison, 1915, page 647 et seq.).

Some of these figures are the result of only a very few tests, and all of them represent short periods of feeding and must be regarded as showing comparative digestibility of the feeds only very roughly. Like chemical composition, a statement of the digestibility of a feed is only a single "pointer" to the feeder, helpful, if it is not over-valued.

TABLE I. DIGESTION COEFFICIENTS.

	Protein	Fiber	Carbo-hydrates	Fat
Cotton Seed Meal	84	37	75	95
Linseed Meal (old process)	89	57	78	89
Wheat Bran	76	43	74	62
Wheat Feed	77	36	76	87
Wheat Middlings	77	30	78	88
Red Dog Flour	88	36	88	86
Corn Gluten Meal	85	55	90	93
Corn Gluten Feed	85	76	88	85
Hominy Feed	66	76	90	91
Dried Brewers' Grains	81	87	80	85
Malt Sprouts	77	87	80	85
Dried Distillers' Grains	73	95	81	95
Dried Beet Pulp	52	83	83	..
Wheat Bran and Corn Cob Feed	63	28	71	92

NUTRITIVE RATIO.

Nutritive ratio is a term with which many dairymen are, and all should be, familiar. The nutritive ratio of a given feed means the ratio between the digestible protein and the amount of digestible carbohydrates (or nitrogen-free extract and fiber) and crude fat (or ether extract) which that feed contains. We have already noted above that protein and carbohydrates have the same energy producing value, and that fat has 2.25 times as much, hence in calculating a nutritive ratio, fat must be first resolved to the same energy basis as carbohydrate which is done by multiplying by the factor 2.25.

Taking as an example, cottonseed meal containing 35.43 per cent of protein, 12.28 per cent of fiber, 32.37 per cent of nitrogen-free extract and 6.50 per cent of fat, the first step is to determine the amount of the several nutrients which are digestible. Referring to the list of coefficients of digestibility, Table I, it is seen that these coefficients for cottonseed meal are protein 84, fiber 37, carbohydrates 75 and fat 95. Multiplying the above percentages by these factors respectively, we find to be digestible 29.8 per cent. of protein, 4.5 per cent fiber, 24.2 per cent nitrogen-free extract, and 6.2 per cent fat. Reducing the digestible fat to the energy equivalent basis of the carbohydrates, we obtain 14.0. The total digestible carbohydrate from nitrogen-free extract and

fiber is $29.8+4.5=34.3$, to which is added the fat $14.=48.3$. The nutritive ratio can now be stated, and is carbohydrate+fat, 48.3: protein, 29.8 or $\frac{48.3}{29.8}=1.6$. The nutritive ratio is therefore 1:1.6. In this way the nutritive ratio of any feed for which coefficients of digestibility have been determined, may be calculated.

COMMENT ON ANALYSES.

(The anaylses are tabulated on pages 466 to 477.)

Cottonseed Meal. This product is recognized by the Association of Feed Control Officials and generally in the trade as a product of the cotton-seed only, composed principally of the kernel with such portion of the hull as is necessary in the manufacture of oil; provided that nothing shall be recognized as cottonseed meal that does not conform to the foregoing definition and that does not contain at least 36 per cent of protein.

There are three classes of meals, viz.: *Choice*, *Prime* and *Good*.

Choice cottonseed meal must be finely ground, not necessarily bolted, perfectly sound and sweet in odor, yellow, free from excess of lint, and must contain at least 41 per cent of protein.

Prime cottonseed meal must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, yellow, not brown or reddish, free from excess of lint, and must contain at least 38.6 per cent of protein.

Good cottonseed meal must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, and must contain at least 36 per cent of protein.

The cottonseed meals examined this year, eleven in number, averaged 35.43 per cent protein, 12.28 per cent fiber, 32.27 per cent nitrogen-free extract, and 6.50 per cent fat. The average price per ton was $57.55. As compared with this product last year the protein content is 2.30 per cent and the fat content 0.15 per cent lower, while the price is $10.60 per ton higher. The average guaranteed amounts of protein and fat were 36.46 per cent and 5.05 per cent respectively, from which it is seen that these feeds as a class fail to meet their guaranty as to protein by 1.03 per cent, and exceed the declared amount of fat by 1.50

per cent. The amount of crude fiber found is a trifle lower than last year, but considerably in excess of amounts found during the six years previous.

Samples which failed to meet their guaranties by 1 per cent or more of protein were one sample of the Buckeye brand; one sample marked Second Class, one sample each of Danish, Pilgrim and Puritan brands.

The brand selling for the highest price, viz.:—$63.00, contained the highest per cent of protein, and was well above guaranty in other respects; but another brand selling for $62.00 was the lowest but one of all samples in content of protein.

Cottonseed Feed is a mixture of cottonseed meal and cottonseed hulls, containing less than 36 per cent of protein.

This class of feeds will become largely recruited from the ranks of those now classed as cottonseed meal if the downward tendency in quality of the latter, as noted in the last few years, continues.

Only one sample of this class was examined this year, and this was in substantial accord with its guaranty.

Linseed Meal is the ground product obtained after extraction of part of the oil from ground flaxseed screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes. Old Process meal is that from which the oil is removed by hydraulic pressure. In the New Process the oil is removed by the use of solvents.

Four samples were examined this year. The average composition was substantially the same as last year. Two equalled or exceeded the guaranteed amount of protein, the others falling less than 1 per cent below. Guaranties of fat were exceeded in all cases. The average price $59.50 is $11.64 higher than the average last year.

Wheat Bran is the coarse outer coating of the wheat berry obtained in the usual commercial milling process from wheat that has been cleaned and scoured.

Wheat Bran with Screenings not Exceeding Mill Run is either wheat bran with the whole mill run of screenings or wheat bran with a portion of the mill run of screenings, provided that such portion is not an inferior portion thereof.

The six samples examined contained an average of 15.13 per cent of protein, 4.99 per cent of fat. One sample bore no statement of guaranty. The others exceeded their guaranties in all cases. The price per ton has advanced $7.70 over the average shown a year ago.

Wheat Mixed Feed is a mixture of the products other than the flour obtained from the milling of the wheat berry.

Ten samples of this class of feeds, averaged 15.88 per cent protein and 5.13 per cent of fat. All exceeded their guaranties in fat, and also, with one exception, in protein. The one deficiency in protein was less than 1 per cent. The average of all ingredients was nearly the same as last year but the price per ton shows an advance of about $12.00.

Wheat Middlings may be *Standard Middlings* (Shorts), which are the fine particles of the outer and inner bran separated from bran and white middlings, or they may be *White Middlings* which are that part of the offal of wheat intermediate between shorts or standard middlings and red dog.

The samples examined exceeded their guaranties as to protein and fat with one exception, in which a deficiency of less than 1 per cent protein was found. As regards price, the maximum last year is the minimum now. There is also a wide variation in price, three brands selling for $44 to $46, and three others for $50 to $68 per ton. The average advance over the prices of a year ago is $14.38 per ton.

Rye Feed and *Rye Middlings* are by-products from the rye grain corresponding to those defined under similar terms for wheat by-products.

Of rye products, three rye feeds and one rye middlings were examined. All exceeded their guaranties in both protein and fat. Variations in price per ton were not so wide as in the case of wheat products but an advance of about 25 per cent over last year's figures is shown.

Corn Gluten Feed is that portion of commercial shelled corn that remains after the separation of the larger part of the starch and the germ by the process employed in the manufacture of cornstarch and glucose.

Only two samples of this class were analyzed. Globe exceeded its guaranty in both protein and fat. Buffalo was found deficient

in fat to the extent of 0.56 per cent. These products, which sold for $40 to $43 last year, are $55 to $58 per ton now.

Hominy Feed (*Hominy Chop*, *Hominy Meal*) is a mixture of the bran coating, the germ and a part of the starchy portion of the corn kernel obtained in the manufacture of hominy grit for human consumption.

Five samples of hominy feed averaged 11.52 per cent protein and 7.00 per cent fat, exceeding their guaranties in all cases. The average price per ton advanced from $45.00 last year to $64.00 now. Prices vary from $45.00 to $75.00. The brand selling for $45.00 has the same amount of protein and nearly the same amount of fat, with other constituents about the same as the brand selling for 66.6 per cent higher.

Oil Cake Meal is obtained by grinding the press cake left after partial removal of oil from the corn germ.* The analysis of the single sample examined appears in Table VI.

Brewers' Grains are the properly dried residue from cereals obtained in the manufacture of beer. They consist chiefly of barley but may contain whatever other cereals were used in conjunction therewith.

The two samples examined satisfied their guaranties except for a negligible deficiency in protein in one case. The composition remains uniform with that shown by previous inspections. The price has advanced during the year from an average of $31.00 to $55.00.

Distillers' Grains are the dried residue from cereals obtained in the manufacture of alcohol and distilled liquors. The product shall bear the designation indicating the cereal predominating.

Two samples were examined. One satisfied the guaranties as to protein and fat within reasonable limits, but contained more than the guaranteed maximum of crude fiber. The other exceeded the guaranteed amount of protein, but was deficient in fat. Last year seven samples of this class ranged in price from $30.00 to $43.00 per ton. One of the brands this year sold for $62.00.

Dried Beet Pulp is the dried residue obtained in the manufacture of beet sugar.* Two samples of this product satisfied their guaranties. Prices last year ranged from $33.00 to $37.00 per ton. The selling price this year was $46.00 and $52.00.

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* Not an A. F. C. O. definition.

Proprietary Mixed Feeds are not products of definite composition. They are an outlet for various by-products and their ingredients will be governed by what is available to the manufacturer to put into them. Besides cereal grains and by-products thereof they may also contain screenings, cereal hulls and other fillers. Salt and saccharine substances such as molasses or corn syrup are also added in some cases.

Many brands bear on the tags, in addition to the chemical guaranty, a statement of the ingredients used. Information of this character, not required by law in this State, is given by the manufacturers of the following brands:

Pennant Stock Feed. Fine white hominy and oat by-products, ½ of 1 per cent of salt.

Bufceco Chop Feed. Ground corn, oats, barley, hominy feed, oat shorts and oat hulls.

Bufceco Steam Cooked Feed. Ground corn, oats, hominy feed, oat shorts, oat middlings, oat hulls and ½ of 1 per cent salt.

Bufceco Horse Feed. Ground oats, corn, barley, wheat middlings, hominy feed, oat shorts, oat middlings, oat hulls, linseed meal, corn gluten feed.

Wirthmore Stock Feed. Ground barley, ground oats, ground hominy meal, ground corn, oatmeal by products, ½ of 1 per cent salt. Part of the ingredients have been cooked or steamed, and are more easily assimilated and have better keeping qualities.

Economic Horse and Mule Feed. Distillers' and yeast grains from corn, rye, barley malt and sprouts, linseed meal, cottonseed meal, brewers' grains from barley, wheat bran, humus, salt, molasses and corn.

H & S Horse, Mule and Dairy Feed. Flaxseed meal, old process oil meal, alfalfa meal, brewers' and rye distillers' grains, pure cane syrup, ½ of 1 per cent salt.

Larro-feed. Cottonseed meal, corn gluten feed, distillers' grains (mainly from corn), dried beet pulp, standard wheat bran, standard wheat middlings, ¾ of 1 per cent salt. Wheat bran and middlings may contain "ground screenings not exceeding mill run."

Peerless Horse Feed, Corn, oats, alfalfa meal, molasses.

King Corn Horse and Mule Feed. Corn, oats, alfalfa and molasses.

Emerald Horse Feed. Cracked corn, oats, barley, alfalfa meal and molasses.

Union Grains. Fowrex distillers' grains, choice cottonseed meal, old process linseed meal, white wheat middlings, wheat bran, hominy meal, gluten feed, brewers' grains, malt sprouts, ½ of 1 per cent salt.

Bufceco Poultry Mash. Ground corn, wheat bran and middlings, hominy feed, corn gluten feed, oat middlings and rolled oats.

Thirty-five brands of this class of feeds were examined. Of these ten failed to meet their guaranties either in protein or fat or both. Deficiencies up to 1 per cent in protein and 0.25 per cent in fat have been disregarded. The deficient brands are as follows:

TABLE II. PROPRIETARY FEEDS BELOW GUARANTY.

No.	Brand	Protein Deficiency%	Fat Deficiency%
9792	Unicorn Dairy Ration	1.81	....
9856	Big Clover Complete Ration	....	0.42
9784	Economic Horse and Mule Feed	3.94	1.19
9821	Horse, Mule and Dairy Feed	....	1.11
9803	Badger Stock Feed	1.37	....
9781	Peerless Horse Feed	....	0.47
9770	Big Q Dairy Ration	2.00	....
9867	Purina Calf Chow Feed	....	0.55
9826	Ryde's Cream Calf Meal	....	1.37
9819	Biles Ready Ration	....	0.46

While our law requires guaranties of protein and fat only, other guaranties, if made, should be correct. In thirteen brands the maximum of crude fiber was declared and in three instances this maximum was exceeded by more than 1 per cent. Thus **9808,** Bufceco, **9781,** Peerless, and **9785,** Emerald, Horse Feeds, contained excess fiber to the extent of 2.31, 2.10 and 4.56 per cent respectively.

Our experience has shown that those proprietary feeds which contain molasses or other added saccharine substance may fail to receive credit for their full amount of crude fat by the official method of extraction. Following our practice of the last few

years, such feeds have been treated first with water to remove sugary materials before the ether extraction was made. The modified method does not give uniformly higher results, but does, we believe, give results closer to the truth.

The following summary shows our experience this year.

TABLE III. FAT IN MOLASSES FEEDS.

No.	Brand	Official Method%	Modified Method%	Guaranty %
9784	Economic Horse and Mule Feed	3.81	3.74	5.00
9821	Horse, Mule and Dairy (Hamlin's)	1.38	2.39	3.50
9858	Atlas Horse Feed	0.93	2.46	1.00
9857	Monogram Feed	1.86	3.01	3.00
9781	Peerless Horse Feed	1.51	1.53	2.00
9785	Emerald Horse Feed	1.24	1.97	2.00
9867	Purina Calf Chow Feed	3.45	2.60	4.00
9861	Good Luck Feed	2.66	2.73	1.50

The prices which prevail for these goods are very high; disproportionate in many instances to the feeding value of the product. Taking the protein content as an index to the feeding value, it is evident that price bears no rational relation to quality. One brand containing the lowest amount of protein, 8.63 per cent, sold for $47.00. Others containing only from 9 to 11.7 per cent protein sold for from $60 to $71.00. Again high protein feeds containing 24 to 24.5 per cent sold for $80 to $90.00. Another containing more of this nutrient, viz. 24.88 per cent, sold for $58.00.

Unusual trade conditions at the present time are naturally reflected in the feed market, and it is idle to discuss prices for they change during such discussion. With the abnormally high prices prevailing for all human food stuffs the price of milk to the consumer is steadily increasing. A glance at the price column in the tables on these pages will convince us that the real problem is not how the dairyman can produce milk profitably, but, rather, how he can produce it at all.

Poultry Feeds. In this class of products, as in the stock feeds, one looks in vain for any relation between price and quality. One brand with 50 per cent protein sells for $82.00 and another with only 19 per cent sells for only $5.00 less. Platco Laying Mash fell below its protein guaranty by 1.68 per cent. Purina Chicken Chowder and Chick Chuck were deficient in fat.

MISCELLANEOUS SAMPLES.

Partial or complete analyses have been made of the following samples, taken and submitted by individuals.

Cottonseed Meal. **10525**, **9752**, **9753**, **9101**, brands or manufacturers not known; **8836**, Rugg Murdock, Boston; **8835**, Humphreys-Godwin Co., Memphis, Tenn.; **9018**, J. E. Soper Co., Boston; **9019**, Meridian Grain & Elevator Co., Meridian, Miss.; **8770**, National Feed Co., St. Louis, Mo., all sent by Coles Co., Middletown.

9999, bought for imported, sent by Herold's Lanedale Farm, New Canaan.

8806, **8807**, American Red Tag Meal, Union Seed & Fertilizer Co., New York; **8763**, Forfat Brand, Humphreys-Godwin Co., Memphis, Tenn.; **8764**, Danish Brand, Humphreys-Godwin Co., Memphis, Tenn., sent by S. J. Orr, West Suffield.

TABLE IV—PROTEIN IN COTTONSEED MEALS.

No.	Found %	Guaranteed %	No.	Found %	Guaranteed %	No.	Found %	Guaranteed %
10525	35.38	36.00	8835	35.56	....	8806	37.81	....
9752	35.44	....	9019	36.94	....	8807	36.50	....
9753	37.94	....	9018	35.69	....	8763	38.31	38.55
9101	36.88	....	8770	35.50	38.50	8764	34.75	36.00
8836	36.81	....	9999	28.56	....			

Wheat Bran—**9599**, Holstein Feed. (Under stock price). Wheat bran with screenings, sent by J. B. Brainard, Bloomfield, contained 10.69 per cent protein. Guaranty, 12 per cent.

Wheat Middlings. **9758**, Washburn-Crosby, sent by L. A. Bevan, contained 15.94 per cent protein.

Corn Meal, **9748**, sent by J. B. Stetson, contained 9.25 per cent protein.

9142, bought for corn meal, sent by G. B. Dimon, Chestnut Hill. This was a coarse feed consisting of corn and wheat products with oat hulls and bran coats. It contained 16.88 per cent of protein.

Gluten Feed. **8960**, KKK Corn Gluten Feed. J. C. Hubinger Bros. Co., Keokuk, Iowa, sent by D. W. Ives, E. Wallingford, contained 24.56 per cent of protein. Guaranty 23 per cent or more.

8884, Buffalo Gluten Feed, sent by Jewett City Grain Co., contained 23.88 per cent protein.

Proprietary Stock Feeds. **8741,** Crosby's Ready Ration, sent by Seymour Grain Buyers' Club, C. R. Newton, Agt., contained 23.88 per cent protein. Guaranty 25 per cent.

9338, Dairy Feed, sent by A. B. Wakeman, Fairfield, contained 20.06 per cent protein.

Poultry Feeds. **9249,** Protox Poultry Food, Fine, American Agricultural Chemical Co., New York, sent by F. M. Peasley, Cheshire, contained 53.13 per cent protein and 5.99 per cent phosphoric acid. Guaranty 55 per cent protein.

8954, Meat Scrap, the L. T. Frisbie Co., New Haven, sent by C. A. Stone, Oakville, contained 41.75 per cent protein.

8955, Meat Scrap, The Conn. Fat Rendering and Fertilizer Co., New Haven, sent by C. A. Stone, Oakville, contained 42.13 per cent protein.

Miscellaneous Feeds. **9760,** Toasted Milk Nuts, sold by J. E. Bartlett, Jackson, Michigan, and sent by C. M. Jarvis, Berlin. The product contained 8.90 per cent water, 1.25 per cent ash, 14.19 per cent protein, 7.91 per cent crude fiber, 66.21 per cent nitrogen-free extract, and 1.54 per cent crude fat. The significance of the name is not apparent to us from any information we have concerning it, and we have no data by which to judge its digestibility. Judging from the analysis the gross supply of nutrient is satisfactory and, if palatable, should be a desirable feed. The price for this product was $30.00 per ton.

9709, Corn Oil Meal, car heated, The Meader-Atlas Co., New York, sent by C. M. Jarvis, Berlin, contained 21.44 per cent protein.

9712, Peanut "Skins" sent by H. H. Worthington of New Milford. This was composed of the thin brown red coat or skin which covers the edible portion of the peanut. Small fragments of peanut were present which accounts in part for the considerable amount of fat found. The sample contained 6.50 per cent water, 2.33 per cent ash, 14.88 per cent protein, 10.12 per cent fiber, 44.43 per cent nitrogen-free extract and 21.74 per cent fat. The bitter taste of these skins is a familiar fact, and their palatability

to animals will decide their use as a fodder. The analysis shows that the sample contains very considerable amounts of nutrient material.

9248, Cracker Waste, Loose Wiles Biscuit Co., sent by C. M. Jarvis, Berlin, contained 6.19 per cent protein.

9401, Damaged Wheat; **9537,** Beans (seconds); **9536,** Damaged Oats, all sent by C. M. Jarvis, Berlin, were analyzed as follows:

	9401	9537	9536
Water	11.20%	15.83%	9.30%
Ash	2.56	3.50	3.95
Protein	11.88	21.75	11.88
Fiber	2.95	3.07	9.60
Nitrogen-free extract	68.57	54.96	60.04
Fat	2.84	0.89	5.23

9547, Grain Siftings, waste, sent by John E. Gifford, County Agent, Rockville. This was found to contain 13.50 per cent of protein, equivalent to 2.16 per cent of nitrogen. It also contained 0.88 per cent total phosphoric acid and 1.24 per cent total potash with 17.44 per cent total ash and 10.33 per cent ash insoluble in acid.

8860, Peanut Meal; **8869,** Damaged Corn (burned); **9411,** Alfalfa Ground Feed; **8870,** Rye and Oats, all sent by C. M. Jarvis, Berlin, were analyzed as follows:

	8860	8869	9411	8870
Water	8.06%	7.75%	14.34%	6.45%
Ash	5.42	1.73	3.95	2.69
Protein	36.56	11.44	15.13	12.38
Fiber	8.15	8.59	13.45	6.76
Nitrogen free extract	35.06	66.35	50.16	68.53
Fat	6.75	4.14	2.97	3.19

Sample 8869 was corn that had been damaged by burning and a considerable part of the "fiber" shown above is charcoal.

8758, Waste Flour, Franco-American Baking Co., sent by Frank N. Platt, Milford, contained 11.06 per cent protein.

9061, Corn and Bean Silage, sent by Karl B. Musser, Storrs, contained, as received, 43.74 per cent water, 1.68 per cent ash, 3.37 per cent protein, 6.84 per cent fiber, 2.01 per cent

crude fat (ether extract), and 12.36 per cent nitrogen-free extract.

A sample of Condensed Buttermilk **10637**, made by the Consolidated Products Co., Lincoln, Neb., and a sample of Dried Buttermilk **10684** obtained from Hales and Edwards Company, Chicago, Ill., were sent to us by C. M. Jarvis of Berlin.

The composition of these products is shown by the following analyses:

	10637		10684	
	As Analyzed %	Dry Basis %	As Analyzed %	Dry Basis %
Moisture	76.97	00.00	8.27	00.00
Solids	23.03	100.00	91.73	100.00
Ash	2.94	12.77	12.15	13.24
Protein	9.57	41.55	31.07	33.87
Milk Sugar	6.98	30.31	34.34	37.43
Fat	2.78	12.07	7.24	7.89
Undetermined	0.76	3.30	6.93	7.57
Calories per lb.	413.0	1,794.0	1,480.0	1,614.0
Nutritive ratio	1:1.4	....	1:1.6	....

Reduced to the dry basis, it is seen that these materials are closely alike, the difference being within the range of normal variations in the composition of buttermilk. The ash consists largely of phosphates of lime and common salt. They are abundantly nutritious and are reported to have been used with success as a feed for pigs. The dried product is more economical to transport, and possesses the added advantage of superior keeping qualities.

The following feeds were submitted by the Dairy Commissioner for examination with reference to their conformity to guaranty.

TABLE V—FEEDS SAMPLED BY THE DAIRY COMMISSIONER.

No.	Brand, Manufacturer or Jobber	Protein Guaranteed %	Protein Found %
	Cottonseed Meal.		
9697	Not given	.....	36.13
11905	Puritan, J. E. Soper Co., Boston	36.00	34.13
11722	American Red Tag, Union Seed & Fer. Co., N. Y.	38.55	37.56
11718	American Red Tag, Union Seed & Fer. Co., N. Y.	38.55	38.75
11717	Puritan, J. E. Soper Co., Boston	36.00	31.44
11716	No. 7, Union Seed & Fertilizer Co., New York	36.00	35.50
11715	National Feed Co., St. Louis, Mo.	38.50	35.00

No.	Brand, Manufacturer or Jobber	Protein Guaranteed %	Protein Found %
	Brewers' Grains.		
11871	Not given	30.00	28.13
	Proprietary Feeds.		
11714	Portage Stock Feed, Ak. Feed & Mill Co., Akron, O.	8.00	8.88
11720	Anchor Dairy Feed, Globe Elevator Co., Buffalo, N. Y.	16.00	13.50
11719	Bonnie Horse Feed, Holmes, Keeler & Kent Co.	13.00	14.13

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	OIL SEED PRODUCTS. *Cotton Seed Meal.*	
9844	Buckeye. Buckeye Cotton Oil Co., Cincinnati, O.	*Middlefield:* Middlefielc Grain & Coal Co. ....
		Guaranty ....
9854	Buckeye. Buckeye Cotton Oil Co., Cincinnati, O.	*Hartford:* Loydon, Nor tham & Loydon ....
		Guaranty ....
9849	Second Class. Byromville Oil Co., Byromville, Ga.	*Hazardville:* A. D. Bridge Sons ....
		Guaranty ....
9851	Danish. Humphreys, Godwin Co., Memphis, Tenn.	*Hartford:* Olds & Whippl
		Guaranty ....
9779	Danish. Humphreys, Godwin Co., Memphis, Tenn.	*Wallingford:* E. E. Hall..
		Guaranty ....
9817	Danish. Humphreys, Godwin Co., Memphis, Tenn.	*Yantic:* A. R. Manning..
		Guaranty ....
9864	Forfat. Humphreys, Goodwin Co., Memphis, Tenn.	*New Haven:* Crittenden Benham Co ....
		Guaranty ....
9815	Puritan. J. E. Soper Co., Boston, Mass.	*New London:* P. Schwart Co ....
		Guaranty ....
9835†	Pilgrim. J. E. Soper Co., Boston, Mass.	*Meriden:* August Grulich
		Guaranty ....
9840	Puritan. J. E. Soper Co., Boston, Mass.	*Colchester:* M. Klingon
		Guaranty ....
9793	Surety. Union Seed & Fert'z'r. Co., Clarksdale, Miss.	*Guilford:* Morse & Landon
		Guaranty ....
		Average guaranty ......
		Average of analyses ......
		Average digestible ....
	Cotton Seed Feed.	
9774	77. Humphreys, Godwin Co., Memphis, Tenn.	*North Haven:* Co-opera tive Feed Co ....
		Guaranty ....
	Linseed Meal, Old Process.	
9799†	American Linseed Co., New York	*West Cheshire:* G. W. Thorp
		Guaranty ....
9841	American Linseed Co., Buffalo, N. Y.	*Colchester:* M. Klingon...
		Guaranty ....
9810	Archer Daniels Linseed Co., Buffalo, N. Y.	*Derby:* Peterson Hendee Cc
		Guaranty ....
9778	Kellogg's. Spencer Kellogg, Buffalo, N. Y.	*Wallingford:* E. E. Hall.
		Guaranty ....
		Average guaranty ....
		Average of anaylses ......
		Average digestible ....
	WHEAT PRODUCTS. *Wheat Bran.*	
9771*	Wm. Hamilton & Son, Honeoye Falls, N. Y. ...	*North Haven:* Co-opera tive Feed Co ....
		Guaranty ....

* With screenings not exceeding mill run. † Wire tags.

SAMPLED IN 1917.

Station No.	Pounds per Hundred						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
9844	7.59	5.74	34.94	12.15	33.20	6.38	$58.00
....	....	....	**36.00**	**14.00**	**30.00**	**5.00**	....
9854	6.84	6.38	35.38	11.86	33.22	6.32	61.00
....	....	....	**36.00**	**14.00**	**30.00**	**5.00**	....
9849	7.94	5.38	34.19	13.54	32.08	6.87	62.00
....	....	....	**36.00**	....	....	....	....
9851	8.15	5.42	31.44	14.84	33.50	6.65	53.00
....	....	....	**36.00**	**15.00**	**25.00**	**5.00**	....
9779	7.65	5.49	35.56	10.84	33.97	6.49	55.00
....	....	....	**36.00**	**15.00**	**25.00**	**5.00**	....
9817	7.93	5.67	36.13	12.13	32.10	6.04	56.00
....	....	....	**36.00**	**15.00**	**25.00**	**5.00**	....
9864	7.75	6.22	39.69	10.17	29.46	6.71	63.00
....	....	....	**38.55**	**12.00**	**25.00**	**5.00**	....
9815	6.41	7.17	35.94	13.10	30.62	6.76	55.00
....	....	....	**36.00**	**15.00**	**30.00**	**5.00**	....
9835	6.93	5.66	36.31	13.00	31.69	6.41	58.00
....	....	....	**38.50**	**10.00**	....	**5.00**	....
9840	8.44	5.28	34.75	11.36	34.12	6.05	58.00
....	....	....	**36.00**	**15.00**	**30.00**	**5.00**	....
9793	8.30	6.31	35.44	12.11	30.94	6.90	54.00
....	....	....	**36.00**	**14.00**	**27.00**	**5.50**	....
....	....	....	**36.46**	....	....	**5.05**[1]	....
....	**7.63**	**5.88**	**35.43**	**12.28**	**32.27**	**6.50**	**57.55**
....	....	....	**29.8**	**4.5**	**24.2**	**6.2**	....
9774	9.16	4.37	19.63	22.73	40.10	4.01	40.00
....	....	....	**20.00**	**28.00**	....	**4.00**	....
9799	10.01	5.31	33.81	7.52	37.08	6.27	60.00
....	....	....	**34.00**	**8.00**	....	**5.00**	....
9841	9.55	5.15	35.31	6.93	36.67	6.39	58.00
....	....	....	**34.00**	....	....	**5.00**	....
9810	9.89	5.29	32.13	6.96	36.66	9.07	64.00
....	....	....	**33.00**	....	....	**6.00**	....
9778	9.77	5.13	33.69	5.61	39.70	6.10	56.00
....	....	....	**33.00**	....	....	**5.00**	....
....	....	....	**33.50**	....	....	**5.25**	....
....	**9.81**	**5.22**	**33.73**	**6.75**	**37.53**	**6.96**	**59.50**
....	....	....	**30.0**	**3.9**	**29.3**	**6.2**	....
9771	9.38	5.43	14.81	8.11	58.20	4.07	45.00
....	....	....	**11.75**	**10.60**	....	**2.15**	....

[1] Ten analyses.

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	WHEAT PRODUCTS—*Continued.* *Wheat Bran—Continued.*	
9865*	Pittsford Milling Co., Pittsford, N. Y.	*New Haven:* Crittende Benham Co. ....
		Guaranty...............
9782	Korno. St. Paul Mill Co., St. Paul Minn.	*Wallingford:* E. E. Hall.
		Guaranty..............
9805	Angelus. Thompson Milling Co., Lockport, N. Y.	*Ansonia:* Ansonia Flour Grain Co...............
		Guaranty...............
9802*	Washburn, Crosby's. Washburn Mills, Minneapolis, Minn.	*West Cheshire:* G. W. Thro
		Guaranty...............
9776*	Black Hawk. Western Flour Mill Co., Davenport, Iowa..............................	*Wallingford:* E. E. Hall..
		Guaranty...............
		Average guaranty........
		Average of analyses......
		Average digestible........
	Wheat Feed (Mixed Feed)	
9816	Bailey Fancy. E. W. Bailey & Co., Montpelier, Vt.	*Yantic:* A. R. Manning..
		Guaranty..............
9811	Bulls Eye. Blish Milling Co., Seymour, Ind. ..	*Derby:* Peterson Hendee C
		Guaranty..............
9777**	Boston. Duluth Superior Mill. Co., Duluth, Minn.	*Wallingford:* E. E. Hall...
		Guaranty...............
9795	Improved Grafton. Grafton Roller Mills, Grafton, No. Dak.	*Middletown:* Meech & Sto dard, Inc.............
		Guaranty..............
9859	Improved Grafton. Grafton Roller Mills, Grafton, No. Dak.	*Waterbury:* Spencer Grai Co., Inc...............
		Guaranty...............
9822	Pennant. National Mill. Co., Toledo, O.	*Norwich:* Chas. Slosberg..
		Guaranty...............
9852	Occident. Russell Miller Mill. Co, Minneapolis, Minn.	*Hartford:* G. M. White...
		Guaranty..............
9809A	Gold Mine. Shefield King Mill. Co., Minneapolis, Minn.	*Shelton:* Ansonia Flour Grain Co.............
		Guaranty...............
9825	Waggoner-Gates Mill. Co., Independence, Mo. .	*Willimantic:* Willimant Grain Co.............
		Guaranty...............
9773	Kent, Williams Bros. Co., Kent, O.	*North Haven:* Co-operativ Feed Co..............
		Guaranty...............
		Average guaranty.........
		Average of analyses.......
		Average digestible........
	Wheat Middlings.	
9789*	Hecker-Jones-Jewell Mill. Co., New York......	*Bridgeport:* Susman-Feue Co.................
		Guaranty...............
9842*	Millbourne. Millbourne Mills, Philadelphia, Pa.	*Colchester:* M. Klingon..
		Guaranty..............
9801*	Ogilvie Flour Mill Co., Winnipeg, Canada.....	*West Cheshire:* G. W. Thor
		Guaranty...............

* With screenings not exceeding mill run. ** With wheat screenings.

SAMPLED IN 1917—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber	Nitrogen-free Extract. (Starch, gum, etc.)	Ether. Extract. (Crude Fat)	
9865	9.93	6.25	14.25	8.96	56.12	4.49	$50.00
....	....	....	....	....	....	....	....
9782	9.45	5.91	14.94	8.56	55.90	5.24	38.00
....	....	....	**14.00**	....	....	**4.00**	....
9805	8.80	5.61	15.88	10.21	53.66	5.84	42.00
....	....	....	**15.00**	....	....	**4.00**	....
9802	8.84	6.15	14.69	13.43	52.52	4.37	42.00
....	....	....	**16.25**	....	....	**4.00**	....
9776	8.94	5.62	16.25	10.35	52.90	5.94	38.00
....	....	....	**13.30**	....	....	**3.00**	....
....	....	....	**14.06**[2]	....	....	**3.43**[2]	....
....	**9.22**	**5.83**	**15.13**	**9.93**	**54.88**	**4.99**	**42.50**
....	....	....	**11.5**	**4.3**	**40.6**	**3.1**	....
9816	9.62	6.65	15.38	7.88	55.80	4.67	48.00
....	....	....	**15.00**	....	....	**3.75**	....
9811	9.66	5.65	15.25	8.33	56.60	4.51	49.00
....	....	....	**16.00**	**9.10**	....	**4.40**	....
9777	9.17	4.14	17.06	7.76	55.81	6.06	45.00
....	....	....	**16.00**	....	....	**4.50**	....
9795	9.36	4.63	16.75	6.88	56.83	5.55	48.00
....	....	....	**14.00**	....	....	**2.70**	....
9859	11.28	4.43	15.94	7.69	55.20	5.46	51.00
....	....	....	**14.00**	....	....	**2.70**	....
9822	9.09	4.80	15.44	6.01	60.02	4.64	49.00
....	....	....	**15.00**	....	....	**3.75**	....
9852	9.42	5.73	15.81	7.41	56.22	5.41	54.00
....	....	....	**15.00**	....	....	**4.50**	....
9809A	9.98	5.02	16.38	8.00	54.89	5.73	51.00
....	....	....	**15.00**	....	....	**4.00**	....
9825	9.46	5.94	15.63	7.36	56.90	4.71	50.00
....	....	....	**15.00**	....	....	**4.00**	....
9773	10.37	4.75	15.19	6.01	59.15	4.53	51.00
....	....	....	**12.00**	....	....	**3.00**	....
....	....	....	**14.70**	....	....	**3.73**	....
....	**9.74**	**5.17**	**15.88**	**7.33**	**56.74**	**5.13**	**49.80**
....	....	....	**12.2**	**2.6**	**43.1**	**4.5**	....
9789	9.49	5.08	16.94	6.97	56.14	5.38	44.00
....	....	....	**15.50**	**8.00**	**54.67**	**4.75**	....
9842	9.90	4.29	15.38	5.57	59.72	5.14	46.00
....	....	....	**16.00**	**3.00**	....	**4.00**	....
9801	10.15	4.08	15.25	7.72	57.63	5.17	46.00
....	....	....	**15.00**	....	....	**4.00**	....

[2] Five analyses.

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	WHEAT PRODUCTS—*Concluded* *Wheat Middlings—Concluded*	
9853	XX Daisy. Pillsbury Co., Minneapolis, Minn..	*Hartford:* G. M. White....
		Guaranty................
9860	B. Pillsbury Co., Minneapolis, Minn.........	*Waterbury:* Spencer Grain Co., Inc................
		Guaranty................
9850	Snowball. Shane Bros. & Wilson Co., Minneapolis, Minn............................	*Hazardville:* A. D. Bridges Sons..................
		Guaranty................
		Average guaranty.........
		Average of analyses.......
		Average digestible.........
	RYE PRODUCTS.	
9824	Feed. Boutwell Mill. Co., Troy, N. Y........	*Willimantic:* Willimantic Grain Co..............
		Guaranty................
9845	Irving Mills Feed. Van Vechten Mill. Co., Rochester, N. Y........................	*Middlefield:* Middlefield Grain & Coal Co........
		Guaranty................
9780	Irving Mills Feed. Van Vechten Mill. Co., Rochester, N. Y........................	*Wallingford:* E. E. Hall...
		Guaranty................
9832	Pure Middlings. Washburn-Crosby Co., Minneapolis, Minn............................	*Wallingford:* Gallagher Bros.
		Guaranty................
	MAIZE PRODUCTS. *Corn Gluten Feed.*	
9806	Globe. Corn Products Refining Co., New York.	*Ansonia:* Ansonia Flour & Grain Co.............
		Guaranty................
9791	Buffalo. Corn Products Refining Co., New York................................	*East Haven:* F. A. Forbes..
		Guaranty................
		Average analyses..........
		Average digestible.........
	Hominy Feed.	
9823	Spring Garden. Baltimore Pearl Hominy Co., Baltimore, Md.......................	*Norwich:* Chas. Slosberg..
		Guaranty................
9837	Bufceco. Buffalo Cereal Co., Buffalo, N. Y....	*Meriden:* Meriden Grain & Feed Co...............
		Guaranty................
9848	Badger. Chas. A. Krause Mill. Co., Milwaukee, Mo....................................	*Thomsonville:* Geo. S. Phelps & Co............
		Guaranty................
9846	Steam Cooked. Miner-Hillard Mill. Co., Wilkes-Barre, Pa.........................	*Middlefield:* Middlefield Grain & Coal Co........
		Guaranty................
9794	Steam Cooked. Miner Hillard Mill. Co., Wilkes-Barre, Pa.........................	*Guilford:* Morse & Landon
		Guaranty................
		Average guaranty.........
		Average of analyses.......
		Average digestible.........
	Oil Cake Meal.	
9801*	Heart of the Corn. Chicago Heights Oil Mfg. Co., Chicago, Ill..........................	*Middletown:* Meech & Stoddard, Inc..............
		Guaranty................

* With s.

SAMPLED IN 1917—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
9853	10.60	3.72	18.44	2.72	59.54	4.98	$68.00
....	....	....	**16.00**	....	....	**4.00**	....
9860	10.74	5.08	16.44	8.53	53.82	5.39	50.00
....	....	....	**14.00**	....	....	**4.00**	....
9850	11.07	4.63	17.88	6.08	54.80	5.54	60.00
....	....	....	**15.00**	....	....	**4.50**	....
....	....	....	*15.25*	....	....	**4.21**	....
....	**10.33**	**4.48**	**16.72**	**6.27**	**56.94**	**5.27**	**52.33**
....	....	....	**12.9**	**1.9**	**44.4**	**4.6**	....
9824	9.64	4.02	15.31	3.90	63.56	3.57	50.00
....	....	....	**13.50**	....	....	**3.00**	....
9845	10.90	3.59	15.44	4.04	62.62	3.41	49.00
....	....	....	**12.00**	....	....	**3.00**	....
9780	9.52	3.69	16.50	6.73	59.93	3.63	48.00
....	....	....	**13.00**	**10.00**	....	**2.00**	....
9832	8.93	4.82	17.19	6.21	59.16	3.69	50.00
....	....	....	**14.00**	....	....	**3.00**	....
9806	8.68	4.38	25.50	7.72	51.68	2.04	58.00
....	....	....	**23.00**	....	....	**1.00**	....
9791	9.65	4.36	25.00	8.09	51.46	1.44	55.00
....	....	....	**23.00**	....	....	**2.00**	....
....	....	**9.17**	**25.25**	**7.91**	**51.57**	**1.74**	**56.50**
....	....	....	**21.5**	**6.0**	**45.4**	**1.5**	....
9823	7.83	3.38	11.38	5.26	65.50	6.65	65.00
....	....	....	**10.00**	....	....	**6.00**	....
9837	9.51	3.57	11.44	4.51	63.75	7.22	75.00
....	....	....	**10.00**	**4.00**	....	**6.00**	....
9848	10.82	3.19	11.44	4.42	2.23	7.90	$65.00
....	....	....	**10.00**	....	....	**6.00**	....
9846	8.59	3.01	11.88	4.40	65.65	6.47	70.00
....	....	....	**10.00**	**3.00**	....	**5.00**	....
9794	9.13	2.97	11.44	4.06	65.61	6.79	45.00
....	....	....	**10.00**	**3.00**	....	**5.00**	....
....	....	....	**10.00**	....	....	**5.60**	....
....	**9.18**	**3.22**	**11.52**	**4.53**	**64.55**	**7.00**	**64.00**
....	....	....	**7.6**	**3.4**	**58.1**	**6.4**	....
9798	8.75	3.18	21.88	7.94	50.84	7.41	50.00
....	....	....	....	....	....	....	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	BREWERY AND DISTILLERY PRODUCTS.	
	Brewers' Grains.	
9855	Bull. Farmers Feed Co., New York..........	*Hartford:* Loydon, Nor tham & Loydon........
		Guaranty...............
9847	Providence Brewing Co., Providence, R. I......	*Thompsonville:* Geo. S Phelps & Co.............
		Guaranty...............
		Average of analyses......
		Average digestible........
	Distillers' Grains.	
9804	Atlas. Atlas Feed & Mill. Co., Peoria, Ill......	*West Cheshire:* G. W. Thorp
		Guaranty...............
		Digestible...............
9772	Dried grains. The Fleishman Co., Chicago, Ill.	*North Haven:* Co-operativ Feed Co..............
		Guaranty..............
		Digestible..............
	MISCELLANEOUS FEEDS.	
9827	Dried Beet Pulp. Holland St. Louis Sugar Co., St. Louis, Mich..........................	*Willimantic:* Willimanti Grain Co..............
		Guaranty...............
9868	Dried Beet Pulp. Michigan Sugar Co., Bay City, Mich..............................	*New Haven:* R. G. Dav & Son................
		Guaranty...............
10207	Cocoa Shell Meal. Hershey Chocolate Co.....	*Colchester:* Colchester Farr Produce Co............
		Guaranty..............
	PROPRIETARY MIXED FEEDS.	
	Horse, Dairy and Stock Feeds.	
9820	Pennant Stock Feed. E. W. Bailey & Co., Swanton, Vt............................	*Norwich:* Chas. Slosberg.
		Guaranty...............
9796	Blatchford's Calf Meal. Blatchford Calf Meal Co., Waukegan, Ill.......................	*Middletown:* Meech & Stod dard, Inc.............
		Guaranty...............
9814	Bufceco Chop Feed. Buffalo Cereal Co., Buffalo, N. Y..........................	*New London:* P. Schwart Co..................
		Guaranty...............
9812	Bufceco Steam Cooked Feed. Buffalo Cereal Co., Buffalo, N. Y........................	*New London:* P. Schwart Co..................
		Guaranty...............
9808	Bufceco Horse Feed. Buffalo Cereal Co., Buffalo, N. Y..........................	*Shelton:* Ansonia Flour Grain Co..............
		Guaranty...............
9792	Unicorn Dairy Ration. Chapin & Co., Hammond, Ind............................	*Branford:* S. V. Osborn...
		Guaranty...............
9856	Big Clover Complete Ration. Clover Leaf Mill. Co., Buffalo, N. Y.......................	*Hartford:* Loydon, Nor tham & Loydon........
		Guaranty...............
9828	Clover Leaf Dairy Feed. Clover Leaf Mill. Co., Buffalo, N. Y..........................	*Willimantic:* Willimanti Grain Co.. ....
		Guaranty...............
9839	Clover Leaf Calf Meal. Clover Leaf Mill. Co., Buffalo, N. Y............................	*Colchester:* David Shea...
		Guaranty...............

Sampled in 1917—*Continued.*

Station No.	Pounds per Hundred						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
9855	6.62	3.41	28.44	13.43	41.47	6.63	$60.00
....	....	....	**27.00**	....	....	**6.00**	....
9847	6.31	3.29	24.81	14.78	44.03	6.78	50.00
....	....	....	**25.00**	....	....	**5.00**	....
....	**6.47**	**3.35**	**26.63**	**14.11**	**42.75**	**6.71**	**55.00**
....	....	....	**21.6**	**6.9**	**24.4**	**6.0**	....
9804	6.07	1.86	32.88	12.61	37.43	9.15	62.00
....	....	....	**30.00**	**14.00**	**30.00**	**10.00**	....
....	....	....	**24.0**	**14.0**	**30.3**	**8.7**	....
9772	6.49	2.60	18.13	23.66	42.14	6.98	44.00
....	....	....	**19.00**	**19.00**	....	**7.00**	....
....	....	....	**13.2**	**22.5**	**34.1**	**6.6**	....
9827	9.57	3.17	10.60	18.39	57.65	0.62	52.00
....	....	....	**8.00**	**20.00**	**58.00**	**0.50**	....
9868	9.62	3.33	8.56	18.06	59.27	1.16	46.00
....	....	....	**8.00**	**20.00**	**58.00**	**0.50**	....
10207	3.46	2.86	16.25	14.34	51.18	11.91	30.00
....	....	....	**14.00**	....	....	....	....
9820	8.71	4.38	9.25	10.48	60.55	6.63	$60 00
....	....	....	**10.00**	**10.00**	....	**6.50**	....
9796	9.89	5.47	23.94	8.09	46.19	6.42	88.00
....	....	....	**24.00**	....	....	**5.00**	....
9814	8.30	3.88	9.06	10.50	62.23	6.03	60.00
....	....	....	**8.00**	**10.00**	**68.00**	**4.00**	....
9812	7.06	3.65	9.94	8.58	64.11	6.66	60.00
....	....	....	**10.00**	**8.00**	....	**4.00**	....
9808	8.35	4.13	11.69	10.31	60.67	4.85	71.00
....	....	....	**11.00**	**8.00**	**60.00**	**4.00**	....
9792	7.88	7.04	24.19	9.81	45.07	6.01	58.00
....	....	....	**26.00**	....	....	**5.50**	....
9856	8.72	7.15	23.06	15.81	41.18	4.08	64.00
....	....	....	**24.00**	....	....	**4.50**	....
9828	8.34	10.51	13.50	17.84	46.29	3.52	50.00
....	....	....	**13.50**	....	....	**3.00**	....
9839	9.57	6.25	22.06	6.95	50.31	4.86	70.00
....	....	....	**19.00**	....	....	**5.00**	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	PROPRIETARY MIXED FEEDS—*Continued.* *Horse, Dairy and Stock Feeds—Continued.*	
9818	Wirthmore Stock Feed. Chas. M. Cox Co., Boston, Mass.	*Yantic:* A. R. Manning.... Guaranty
9784	Economic Horse & Mule Feed. Economic Feed Co., New York	*Milford:* E. L. Oviatt..... Guaranty
9790	Stock Feed. John W. Eshelman, Lancaster, Pa.	*Bridgeport:* Susman-Feuer Co. Guaranty
9821	Horse, Mule and Dairy Feed. Dwight E. Hamlin, Pittsburgh, Pa.	*Norwich:* Chas. Slosberg.. Guaranty
9787	Pul Mor Horse Feed. Chas. A. Krause Mill. Co., Milwaukee, Wis.	*Bridgeport:* Susman-Feuer Co. Guaranty
9803	Badger Stock Feed. Chas. A. Krause Mill. Co., Milwaukee, Wis.	*West Cheshire:* G. W. Thorpe Guaranty
9833	Dairy Feed. Chas. A. Krause Mill. Co., Milwaukee, Wis.	*Meriden:* August Grulich.. Guaranty
9834	Stock Feed. Chas. A. Krause Mill. Co., Milwaukee, Wis.	*Meriden:* August Grulich.. Guaranty
9836	Crescent Horse Feed. Chas. A. Krause Mill. Co., Milwaukee, Wis.	*Meriden:* August Grulich.. Guaranty
9838	Larro-feed. Larrowe Milling Co., Detroit, Mich.	*Meriden:* Meriden Grain & Feed Co. Guaranty
9858	Atlas Horse Feed. The Meader Atlas Co., New York	*Hartford:* Loydon, Northam & Loydon. Guaranty
9813	Meadowland Dairy Ration. Metropolitan Mills, New York	*New London:* P. Schwartz Co. Guaranty
9857	Monogram Feed. Metropolitan Mills, New York	*Hartford:* Loydon, Northam & Loydon. Guaranty
9781	Peerless Horse Feed. Omaha Alfalfa Mill. Co., Omaha, Neb.	*Wallingford:* E. E. Hall... Guaranty
9831	Stevens 44 Dairy Ration. Park & Pollard Co., Boston, Mass.	*Wallingford:* Gallagher Bros. Guaranty
9869	King Corn Horse & Mule Feed. M. C. Peters Mill. Co., Omaha, Neb.	*New Haven:* R. G. Davis & Son. Guaranty
9809B	King Corn Horse & Mule Feed. M. C. Peters Mill. Co., Omaha, Neb.	*Shelton:* Ansonia Flour & Grain Co. Guaranty
9785	Emerald Horse Feed. Prairie State Mill. Co., Chicago, Ill.	*Bridgeport:* Standard Feed Co. Guaranty
9786	Green Cross Horse Feed. Quaker Oats Co., Chicago, Ill.	*Southport:* C. Buckingham & Co. Guaranty
9783	Schumacher's Stock Feed. Quaker Oats Co., Chicago, Ill.	*Milford:* E. L. Oviatt.... Guaranty

SAMPLED IN 1917—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
9818	7.94	3.97	9.94	10.40	60.97	6.78	$60.00
....	....	....	**9.00**	**9.50**	**60.00**	**4.00**	....
9784	10.01	5.25	14.06	11.53	55.34	3.81	65.00
....	....	....	**18.00**	**16.00**	....	**5.00**	....
9790	8.39	4.28	11.44	9.30	61.55	5.04	70.00
....	....	....	**10.00**	....	....	**3.00**	....
9821	8.46	9.36	13.56	15.67	50.56	2.39	58.00
....	....	....	**14.00**	**16.00**	**58.00**	**3.50**	....
9787	9.47	7.84	10.69	15.71	54.92	1.37	55.00
....	....	....	**9.00**	....	....	**1.00**	....
9803	8.40	4.65	8.63	15.97	58.02	4.33	47.00
....	....	....	**10.00**	....	....	**4.50**	....
9833	7.19	6.31	24.88	11.16	43.73	6.73	58.00
....	....	....	**24.00**	....	....	**5.00**	....
9834	7.39	4.90	9.19	13.17	59.01	6.34	60.00
....	....	....	**10.00**	....	....	**4.00**	....
9836	9.25	7.89	10.94	14.97	55.33	1.62	58.00
....	....	....	**10.00**	....	....	**1.00**	....
9838	8.54	5.11	20.50	11.82	49.47	4.56	55.00
....	....	....	**20.00**	**14.00**	**50.00**	**3.00**	....
9858	7.72	8.52	7.31	17.04	56.95	2.46	50.00
....	....	....	**8.00**	....	....	**1.00**	....
9813	7.76	5.58	20.69	21.25	39.36	5.36	58.00
....	....	....	**18.00**	....	....	**3.50**	....
9857	8.58	6.95	13.13	16.43	51.90	3.01	56.00
....	....	....	**14.00**	....	....	**3.00**	....
9781	10.03	7.16	12.06	14.10	55.12	1.53	56.00
....	....	....	**10.00**	**12.00**	**55.00**	**2.00**	....
9831	7.03	4.87	23.88	13.29	43.38	7.55	58.00
....	....	....	**24.00**	....	....	**5.00**	....
9869	9.58	7.98	12.13	16.95	51.92	1.44	58.00
....	....	....	**10.00**	**18.00**	**50.00**	**1.50**	....
9809B	8.45	5.72	11.94	16.98	55.62	1.29	58.00
....	....	....	**10.00**	....	....	**1.50**	....
9785	7.60	7.83	12.56	16.56	53.48	1.97	60.00
....	....	....	**10.00**	**12.00**	**50.00**	**2.00**	....
9786	9.94	5.10	9.69	13.18	59.26	2.83	57.00
....	....	....	**10.00**	....	....	**2.50**	....
9783	8.55	5.65	11.75	11.32	58.46	4.27	60.00
....	....	....	**10.00**	....	....	**3.25**	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	PROPRIETARY MIXED FEEDS—*Concluded.* *Horse Dairy and Stock Feeds—Concluded.*	
9770	Big Q Dairy Ration. Quaker Oats Co., Chicago, Ill.	*North Haven:* Co-operative Feed Co.
		Guaranty
9775	Schumacher's Calf Meal. The Quaker Oats Co., Chicago, Ill.	*North Haven:* Co-operative Feed Co.
		Guaranty
9867	Purina Calf Chow Feed. Ralston Purina Mills, St. Louis, Mo.	*New Haven:* Crittenden-Benham Co.
		Guaranty
9861	Good Luck Feed. Ralston Purina Mills, St. Louis, Mo.	*So. Norwalk:* S. Roodner
		Guaranty
9826	Ryde's Cream Calf Meal. Ryde & Co., Chicago, Ill.	*Willimantic:* Willimantic Grain Co.
		Guaranty
9819	Biles Ready Ration. Union Grains. Ubiko Mill. Co., Cincinnati, O.	*Yantic:* A. R. Manning
		Guaranty
	POULTRY FEEDS.	
9807	Bufceco Poultry Mash. Buffalo Cereal Co., Buffalo, N. Y.	*Ansonia:* Ansonia Flour & Grain Co.
		Guaranty
9870	Globe Egg Mash. Albert Dickenson Co., Chicago, Ill.	*New Haven:* R. G. Davis & Sons
		Guaranty
9788	Laying Mash. John W. Eshelman, Lancaster, Pa.	*Bridgeport:* Susman-Feuer Co.
		Guaranty
9800	Blue Ribbon Laying Mash. Globe Elevator Co., Buffalo, N. Y.	*West Cheshire:* G. W. Thorpe
		Guaranty
9707	M. & S. Dry Mash. Meech & Stoddard, Inc., Middletown, Conn.	*Middletown:* Meech & Stoddard, Inc.
		Guaranty
9862	Lay or Bust Dry Mash. Park & Pollard Co., Boston, Mass.	*Norwalk:* C. E. Slauson & Co.
		Guaranty
9863	Growing Feed. Park & Pollard Co., Boston, Mass.	*Norwalk:* C. E. Slauson & Co.
		Guaranty
9829	Platco Laying Mash. Frank S. Platt Co., New Haven, Conn.	*New Haven:* Frank S. Platt Co.
		Guaranty
9866	Purina Chicken Chowder. Ralston Purina Mills, St. Louis, Mo.	*New Haven:* Crittenden-Benham Co.
		Guaranty
9830	Chic Chuck. Russia Cement Co., Gloucester, Mass.	*New Haven:* Frank S. Platt Co.
		Guaranty

SAMPLED IN 1917—*Concluded*.

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether. Extract. (Crude Fat)	
9770	8.71	5.26	19.00	10.37	50.71	5.95	$59.00
....	....	....	**21.00**	**10.50**	....	**6.00**	....
9775	7.14	4.14	19.00	1.91	57.02	10.79	80.00
....	....	....	**18.00**	....	....	**8.00**	....
9867	10.02	3.59	33.69	3.40	45.85	3.45	94.00
....	....	....	**33.00**	....	....	**4.00**	....
9861	10.02	6.20	11.69	5.17	64.19	2.73	58.00
....	....	....	**9.00**	....	....	**1.50**	....
9826	10.82	5.85	24.50	7.10	48.10	3.63	90.00
....	....	....	**25.00**	....	....	**5.00**	....
9819	7.35	5.60	24.06	10.04	46.41	6.54	62.00
....	....	....	**24.00**	**10.00**	**50.00**	**7.00**	....
9807	9.11	4.42	16.13	5.62	59.37	5.35	69.00
....	....	....	**15.00**	**5.00**	....	**4.00**	....
9870	10.42	5.37	16.63	7.59	55.28	4.71	72.00
....	....	....	**15.00**	....	....	**3.00**	....
9788	8.73	9.61	21.75	6.60	46.48	6.83	75.00
....	....	....	**20.00**	**7.00**	....	**5.00**	....
9800	8.69	6.59	20.88	8.23	50.47	5.14	70.00
....	....	....	**20.00**	....	....	**3.00**	....
9707	9.26	8.32	17.63	7.03	52.60	5.16	68.00
....	....	....	**12.00**	....	....	**3.00**	....
9862	9.95	12.07	19.81	7.04	46.09	5.04	75.00
....	....	....	**18.00**	....	....	**1.50**	....
9863	10.45	6.66	16.06	14.30	48.83	3.70	75.00
....	....	....	**10.00**	....	....	**1.50**	....
9829	9.00	14.40	18.63	5.12	46.37	6.48	65.00
....	....	....	**20.31**	....	....	**5.54**	....
9866	10.29	7.10	18.75	7.16	53.33	3.37	77.00
....	....	....	**18.00**	....	....	**4.00**	....
9830	5.59	39.44	50.63	....	....	1.37	82.00
....	....	....	**50.00**	....	....	**2.00**	....

INDEX.

	PAGE
Abbott's sawfly	237
Acetanilid tablets	171
Acetasol tablets	161
Acid phosphate	381
Acremoniella atra	241
Acronycta rumicis	242
Adalia bipunctata	298
Aedes cantator	352
sollicitans	352
Agrilus sinuatus	361
Aleyrodes	242
Allograpta obliqua	299
Alpha Portland Cement Co.:	
Alpha Potash-Lime Fertilizer	373
Alypia octomaculata	358
Ameloctonus oedemisiae	330
American Agricultural Chemical Co.:	
Basic Lime Phosphate	379, 380
Dissolved Acid Phosphate	373
High Grade Acid Phosphate	373
14% Acid Phosphate	382
16% " "	381, 382
18% " "	381, 382
Ammoniated Fertilizer A	404
" " AA	404
" " AAA	404
" " AAAA	404
Castor Pomace	378, 379
Cereal & Root Fertilizer	404
Complete Manure for Top Dressing, 1916	392, 394
Tobacco Fertilizer without Potash	412
Dry Ground Fish	384
Fine Ground Bone	388
Grain & Seeding Fertilizer	373, 374, 412
Great Harvest Potato Special	373
Ground Tankage 6 & 30	386
H. G. Top Dressing without Potash	387, 404
Lion Brand Potato Manure	373
Monarch Potato Manure	373
Nitrate of Soda	375
Odorless Grass & Lawn Top Dressing Revised	373
" " " " " " without Potash	404
Pulverized Sheep Manure	416
Special Vegetable Fertilizer	404

PAGE

American Agricultural Chemical Co., *cont'd* :—
Sure Growth Phosphate, 1916 .... 392, 394
Triumph Crop Special 394
Bradley's B. D Sea Fowl Guano, 1916 394
Complete Manure for Potatoes & Vegetables, 1916 394
for Top Dressing Grass & Grain, 1916 373
Corn Phosphate, 1916 394
Eclipse Phosphate, 1916 373
Extra Potato & Root Special 373
General Fertilizer 404
Grain Fertilizer 404
Grass Top Dressing without Potash 404
Half Century Fertilizer, 1916 394
New Method Fertilizer, 1916 394
Northland Potato Grower 373
Patent Superphosphate, 1916 .... 392, 394
Potato Fertilizer, 1916 394
Manure, 1916 394
Root Crop Manure 404
Special Corn Phosphate without Potash 404
Potato Manure " " 404
Phosphate " " 404
Tobacco Manure (Carb.) 394
" " 1916 (Sulph.) 394
" " without Potash 404
Triplex Potato Special 373
Unicorn, 1916 394
Universal Crop Phosphate 404
East India Corn King, 1916 394
Economizer Phosphate, 1916 373
Mayflower, 1916 373
Pilgrim Fertilizer, 1916 373
Potato & Garden Manure 394
Roanoke Phosphate, 1916 394
Tobacco Special, 1916 (Sulph.) 394
without Potash 404
Unexcelled Fertilizer, 1916 394
Quinnipiac Ammoniated Dissolved Bone, 1916 394
B Fertilizer, 1916 394
Climax Phosphate, 1916 394
Corn Manure, 1916 373
Fish & Potash Mixture, 1916 394
Market Garden Manure, 1916 394
Phosphate, 1916 373
Potato Phosphate, 1916 394

PAGE

American Agricultural Chemical Co., *cont'd*:—
Quinnipiac Special Corn Manure without Potash........ 404
Potato Phosphate without Potash.... 404
Wrapper Leaf Brand Tobacco Manure, 1916. 394, 402
without Potash, 393, 404, 414
Wheeler's Corn Fertilizer, 1916...................... 394
Cuban Tobacco Grower, 1916.............. 394
Potato Manure, 1916...................... 394
W. & C.'s Americus Corn Phosphate, 1916............ 394
H. G. Special for Potatoes & Root Crops, 1916.................. 394
Potato Manure, 1916............. 394
Elk Brand, 1916......................... 394
Matchless Fertilizer, 1916................. 373
Meadow Queen Fertilizer, 1916............. 394
Royal Phosphate, 1916.................... 373
Seed Leaf Tobacco Manure, 1916........... 394
without Potash.. 404
Special Americus Corn Phosphate without Potash................ 404
Potato Manure without Potash................ 404
Prolific Crop Producer..................... 394
Ammonia in bread.................................. 118, 129
Ammonium Salicylate tablets......................... 162
Anarsia lineatella.. 318
Anastatus bifasciatus.................................. 250 251
Angoumois grain moth................................ 337, 344
Ant...312, 339, 344
little red or Pharoah's......................234, 235, 309, 314
Anthracnose of bean..................................... 61
currant.. 68
maple.. 76
onion.. 78
privet... 87
raspberry...................................... 87
snapdragon..................................... 90
watermelon..................................... 95
Anthrenus verbasci.. 338
Antiseptic tablets... 162
Apanteles hyphantriae.................................... 323
lacteicolor............................250, 251, 323, 329
Aphid, apple.. 235, 259
green.. 57, 259
rosy......................................57, 259, 356
cabbage.. 63

PAGE

Aphid, cherry 65
elm woolly 70
peach, green 80, 293
pine bark 83
potato 85, 236, 290, 357
spinach 293
spruce gall 90, 237
turnip 94, 358
wheat 95
woolly 57, 70, 242
apple 57
Aphidius polygonaphis 299
rosae 299
Aphis pomi 259
psuedobrassicae 358
sorbi 259, 356
Apiary inspection in Connecticut 235, 242, 445
Apothecaries Hall Co.:
Acid Phosphate 14% 382
Bone 388
Castor Pomace 378, 379
Ground Fish 384
Nitrate of Soda 375
Tankage 386
Victor Corn, Fruit & All Crops 404
Corn Phosphate 373
Market Gardeners' Special 404
Potato & Vegetable Special 404, 414
Tobacco Special 394
" " without Potash 404
Top Dresser for Grass & Grain 404
Apple aphids 57, 235, 259
borer 57, 237
insects and fungi 56
maggot 57, 358
orchards, general treatment of 59
red-bug false 234, 235, 259, 356
Arkady Yeast Food 115, 128
Armour Fertilizer Works:
Acid Phosphate, 16% 381, 382
Armour's 1- 8-2 Fertilizer 390, 396
2- 8-3 " 396
2½-8-1 " 396
3- 8-1 " 396
3-10-0 " 404
4- 8-0 " 404
4- 8-1 " 396

PAGE

Armour Fertilizer Works, *cont'd*:—
Armour's 5- 8-4 Fertilizer 387, 396
5-10-0 " 404
7- 6-1 " 387, 396
Bidwell's 3-8-1 .... 387, 392, 396
Bone Meal 388
Grain Grower, 2-8-2 Fertilizer 396
Special Tobacco Grower No. 1, 5-4-1 Fertilizer 396
No. 2, 5-4-0 " 404
Wheat, Corn, Oats, Special 1-7-1 Fertilizer 390, 396
Army worm 72, 359, 360
fall 72
Arsenious Iodid Compound 163
Ascomycetes 242
Ash borer 237
Ash of feeding stuffs 451
Ashes, composition of "Canada hard-wood" 47
cotton hull 383
wood 417
from brass mills, analyses of 51
brick kilns, analyses of 50
brush heaps, composition of 49
corn cobs, composition of 49
factory sweepings 422
household fires, composition of 47
smoke-house analyses of 52
witch hazel stills, analyses of 51
of corn cobs, composition of 49
seaweeds 52
Asparagus beetles 60
miner 60
rust 60
Aspirin tablets 164
Asters, yellows of 61
Atlantic Packing Co.:
Atlantic Corn & Grain Fertilizer 404
Potato Phosphate 404
Special Vegetable 404
Tankage 386
Tobacco Special 387, 404
Top Dresser for Grass & Market Gardens 404
Attagenus piceus 339
Autographa brassicae 358
Baker Castor Oil Co.:
Pure Castor Pomace 379
Baking tests with yeast improver 115
Baldwin spot 58

PAGE

Barium phosphate 383
Bark miner 363
Barley as breakfast food 20
    treatment of fungi on 61
Basic lime phosphate 379
Bean weevil, common 61, 333, 340, 343, 344
    four-spotted 61, 333
Beans, acidity of liquor in canned 112
    amount of tin in canned 111
    cost per can 107
        pound of drained canned 108
    examination of canned 102
    insects and fungi attacking 61
    net weight of canned 106
Beekeeping for Connecticut 423
    publications on 446
Bees diseases of 441
    races of 434
Beet, insects and fungi attacking 62
    pulp 457, 472, 473
Beetle, bacon 339
    cabinet, large 338, 344
        small 338, 344
    calosoma 250
    carpet, black 338, 344
    cigarette 339, 344
    Colorado 85
    cucumber 67, 234, 236, 262, 357
    drug store 334, 343
    elm leaf 69, 357, 362
    flour, confused 334, 343
        rust-red 334, 343
    grain 331
        saw-toothed 334, 341, 344
    ground 323
    ham, red-legged 339, 344
    lady, convergent 298
        glacial 298
        nine-spotted 298
        parenthesis 298
        red 298
        spotted 298
        thirteen-spotted 298
        two-spotted 298
    larder 339, 344
Begonia, leaf-blight eelworm 62

PAGE

Berkshire Fertilizer Co.:
Berkshire Ammoniated Bone Phosphate.............. 406
Dry Ground Fish.......................... 384
Economical Grass Fertilizer................ 406
Fine Ground Bone........................ 388
Grass Special............................ 406
Market Garden Fertilizer.................. 406
Potato & Vegetable Phosphate.............. 406
Root Fertilizer.......................... 406
Tobacco Grower.......................... 406
Ground Castor Pomace 379
Nitrate of Soda.............................. 375
Precipitated Phosphate........................ 381
Birch bucculatrix................................ 62
insects attacking.......................... 62
leaf-skeletonizer.......................... 62
Biscuits, analyses of............................ 155
Black knot...................................... 65, 84
leg of potato.............................. 85
rot.. 58
of cabbage............................ 64
grapes.............................. 71
quince.............................. 87
Blackberry, insects and fungi attacking.............. 62
Blatta corticum................................. 306
indica................................... 306
melanocephala............................ 306
punctata................................. 306
surinamensis............................. 306
Blaud's Compound............................... 164
Blight, chestnut................................ 66, 237
of beans.............................. 62
pear.............................. 82
pine.............................. 83
potato............................ 86
Blister beetles.................................. 61
rust on currant.......................... 69
pine.......................... 84
Board of Control, report of...................... v
Boardman, F. E.:
Boardman's Fertilizer for Potatoes & General Crops.... 406
Tobacco Fertilizer...................... 406
Bone manures.................................... 386
Book louse...................................... 339, 344
Bordeaux mixtures, formulas for.................. 54, 55
Borer, apple.................................... 57, 237
ash.. 237

PAGE

Borer, blackberry crown 62
bronze birch 62
cane 62
currant 68
lilac 75, 237
linden 75, 237
maple 75
peach 80, 358
twig 318
pear, sinuate 361
poplar 85
sawfly 359
shot-hole 80, 237
twig 360
Bowker Fertilizer Co.:
Bowker's All Round Fertilizer, 1916 396
Ammoniated Food for Flowers 396
Complete 387, 396
" Alkaline Tobacco Grower, 1916 373
Corn Phosphate, 1916 396
Farm & Garden Phosphate, 1916 396
Four Ten Hill & Drill 406
Fresh Ground Bone 388
High Nitrogen Mixture without Potash 406
Hill & Drill Phosphate, 1916 396
Lawn & Garden Dressing, 1916 396
One Ten Sure Crop 406
Potato Phosphate, 1916 373
Soluble Phosphate 382
Superphosphate with Ammonia 1% 373
2% 406
3% 406
4% 406
5% 406
Sure Crop Phosphate, 1916 396
Three Ten All Round 406
Tobacco Grower, 1916 406
Two Ten Corn 406
" " Potato 406
Stockbridge Complete 373
Early Crop Manure, 1916 396
Five Eight General Crop 406
" Ten Early Crop 406
General Crop Manure, 1916 396
Brachyacantha ursina 299
Brass mills, analyses of ashes from 51
Bread, analyses of 118

PAGE
Bread, baking formulas for 120
cottonseed 155
determination of fat in 133
experiments with 113
loss of dry matter in baking 120
nutrients in baking 130
losses in weight of, after baking 134
variations in weight of loaves of 137
Breads, composition of 126
Breakfast foods, comparative food value of cereal 22
package weights and prices of 28
composition of cereal 22, 32–39
cooking of cereal 26
cost of 29
cereal 27
costs and net weights of 138
digestibility of cereal 24
in package form, composition and cost of 24
number of calories yielded by 29
suggestions as to purchase of 30
weights of one serving of 29
Brewers' grains 457, 472, 473
Brick kilns, analyses of ashes from 50
Brittle of onion 79
Bromine in bread, determination of 119, 130
Bronchitis tablets 165
Brosia meals 139
Brown, F. O.:
Brown's Special for Oats & Top Dressing 406
Formula for Potatoes & General Crops 406
Brown rot 84
of peach 80
Brown-tail moth 82, 234, 235, 246, 247, 359
Bruchus obtectus 333
pisorum 332
quadrimaculatus 333
Butter and its substitutes 208
tests of 140
Buttermilk, condensed 464
Cabbage aphis 63
black rot of 64
club root of 64
looper 63, 358
root maggot 63, 357
soft rot of 64
worm 63
imported 358

PAGE

Cabinet beetle, large . . . 338, 344
small . . . 338, 344
Cadelle . . . 332, 343
Calandra granaria . . . 335
oryzae . . . 335
Calcium sulphate in bread . . . 118, 128
Calcreose . . . 166
Calico of tobacco . . . 92
Calomel tablets . . . 166
Calories needed per day, number of . . . 8
yielded by standard portions of food . . . 10
Calory, definition of . . . 6
Calosoma beetle . . . 250
Calosoma frigidum . . . 265
scrutator . . . 323
sycophanta . . . 250, 252
Campoplex fugitivus . . . 323
oedemisiae . . . 330
pallipes . . . 323
Cane borer, blackberry . . . 62
raspberry . . . 87
Canker, European . . . 85
poplar . . . 237
worms . . . 56, 357
Cankers . . . 58
Carbohydrates, definition of . . . 5
in nutrition, uses of . . . 6
Carbon disulphide as insecticide . . . 53
Carnation, insects and fungi attacking . . . 64
Carpet beetle, black . . . 338, 344
Cascara Compound tablets . . . 169
Castor pomace . . . 378, 379
Caterpillar, red-humped . . . 57, 237, 329, 358
tent . . . 56, 252, 357, 358, 362, 363
walnut . . . 95, 326, 358
yellow-necked . . . 57, 328, 358
Cathartic Compound tablets . . . 169
Cedar, insect and fungus attacking . . . 64
Cedar-apple rust . . . 65
Celatoria diabroticae . . . 267
Celery, insect and fungi attacking . . . 65
Cerambycobius . . . 283
Cereal breakfast foods . . . 19
types of . . . 19
Chafer, rose . . . 71, 88, 357
Chard, insects and fungi attacking . . . 62
Cheese, analysis of cottage . . . 195

PAGE

Cheese, skipper.......... 339, 344
Chelymorpha argus.......... 362
Cherry, insects and diseases attacking.......... 65
slug.......... 65
Chestnut blight.......... 66, 237
borer, two-lined.......... 66
insects and fungi attacking.......... 66
weevil.......... 66
Chicago Feed and Fertilizer Co.:
Ground Sheep Manure.......... 416, 422
Chittenden, The E. D., Co.:
Chittenden's Complete Tobacco & Onion Grower 2% Potash.......... 396
Conn. Tobacco Grower.......... 396
Dry Ground Fish.......... 384
Tobacco Special 2% Potash.......... 396
Vegetable & Onion Grower without Potash 406
Chocolate.......... 140
Chrysanthemums, rust of.......... 67
Chrysopa.......... 299
Cigarette beetle.......... 339, 344
Cirphis unipuncta.......... 359, 360
Cistela melanocephala.......... 263
Clark, The Everett B., Seed Co.:
Clark's Ammoniated Bonephosphate.......... 406
Special Mixture.......... 373
Club root.......... 64
Coccinella novemnotata.......... 298, 299
sanguinea.......... 298
Cockroach.......... 234, 235 302, 339, 344
Australian.......... 304
Cocoa.......... 140
Codling moth.......... 56, 261
Coe-Mortimer Co.:
Castor Pomace.......... 379
E. Frank Coe's Basic Fruit & Legume Phosphate.......... 380
Columbian Corn & Potato Fertilizer, 1916 396
Conn. Wrapper Grower without Potash. 406
Excelsior Potato Fertilizer, 1916.......... 406
Extra Special Potato Fertilizer Revised 373
Gold Brand Excelsior, 1916.......... 396
H. G. Ammoniated Superphosphate, 1916 406
Potato Fertilizer Revised.......... 396
Soluble Phosphate.......... 382
Morcoe Top Dresser without Potash.......... 406
New Englander Special, 1916.......... 393, 396
Prolific Crop Producer, 1916.......... 406

PAGE

Coe-Mortimer Co., *cont'd.*:—
E. Frank Coe's Red Brand Excelsior Guano, 1916...... 387, 396
16% Superphosphate.................. 382
Standard Potato Fertilizer, 1916........ 396
XXV Ammoniated Phosphate, 1916..... 406
Fine Ground Bone.............................. 388
Ground Tankage, 6 & 30.......................... 386
Nitrate of Soda.................................. 375
12% Blood Tankage.............................. 373
Coffee chaff.. 421
condensed...................................... 140
grounds... 421
residue, analysis of............................. 195
substitutes, analyses of......................... 141
Cold tablets... 170
Colletotrichum lagenarium......................... 264
Colony, the bee..................................... 433
Colorado beetle..................................... 85
Comb foundation................................... 432
honey... 436
Compsilura concinnata............................. 250
Condensed Coffee.................................... 140
Confused flour beetle.............................. 334, 343
Conn. Fat Rendering & Fertilizing Corporation:
Tankage... 386
Contarinia tritici................................. 357, 366
Contents, table of.................................. iv
Copper carbonate solution formula.................. 55
lime-sulphur solution formula.................. 55
sulphate solution formula...................... 55
Cordials, composition of............................ 145
Corn cobs, composition of ashes of.................. 49
ear worm.. 67
gluten.. 456, 470, 471
insects and fungi attacking.................... 67
leaf blight..................................... 67
meal... 461
products as breakfast food..................... 20, 39
smut... 67
Correction.. iv
Cottage cheese, analysis of........................ 195
Cotton hull ashes................................... 383
Cottonseed bread.................................... 155
feed....................................... 454, 466, 467
meal..........................376, 454, 461, 466, 467
below guaranty........................... 377
Cranberry fruit worm................................ 67

PAGE
Cranberry, insects attacking 67
worm, yellow-headed 67
Cream 141
Crickets 358, 364
Crioceris vittata 263
Crown gall 63, 84, 241
of rose 88
Crude fiber, meaning of 452
Cryptocephalus americanus 263
Cucumber beetle 234, 236, 262, 357
striped 67
insects and fungi attacking 68
Curculio of plum 84
poplar 85
quince 87
Curculios 56, 261
Currant borer 68
insects and diseases attacking 68
stem girdler 68
worm 68
Cutworms 93, 310, 357
Cycloneda munda 298
Cynthia moth 362
Dahlia, insects affecting 69
Dampening off 83, 92, 93
of tobacco 93
Darker meal worm 332
Datana integerrima 326, 358
ministra 237, 328, 358
Delomerista 283
Dermestes lardarius 339
Desmia funeralis 360
Diabetic foods 142
Diabrotica longicornis 266
12-*punctata* 266
vittata 262, 357
Dibrachoides verditer 283, 284, 287
Dibrachys boucheanus 323
nigrocyaneus 283, 284, 287
Digestion coefficients of feeds 453
Diprion abietis 360
pini 274, 276, 285, 287, 288, 289, 290
simile 234, 235, 273
Dissolved rock phosphate 381
Distillers' grains 457, 472, 473
Downy mildew of melon 77
potato 86

PAGE

Drones 434
Drug products, report on 101, 161
store beetle 334, 343
Drugs from stock of physicians 161
summary of examinations of drugs 198
tests of miscellaneous 193
Eelworm causing root knot of snapdragon 89
of begonia 62
violets 94
Egg plant, insects and fungi attacking 69
Eggs, tests of 154
Eight-spotted forester 358
Eldredge, T. H.:
Fish & Potash 396
Elixir Lactated Pepsin 180
of Iron, Quinin and Strychnin 180
Elm, insects affecting 69
leaf beetle 69, 357, 362
scale 70, 237
Emphytus cinctus 242
Empusa 299
gryllii 323
Entomological department, publications of 232
summary of work of 232
Entomologist, receipts and expenditures of 231
report of 231
Entomophthora 299
aphidis 300, 301
Ephestia kuehniella 337
Eremotylus glabratum 323
Ergot of rye 89
Erratum iv
Essex Fertilizer Co.:
Essex Potato, Corn & Vegetable Fertilizer 406
Manure 406
Phosphate 406
Tobacco Manure 406
XXX Fish Fertilizer 406
Ether extract 452
European grain moth 338, 344
lackey moth 241, 362
Eurytoma 283
Euschistus servus 323
Exobasidium vaccinii 241
Exorista petiolata 283
Extractor for honey 438
Fall web-worm 82, 237, 319, 324, 325, 358

PAGE

False tarnished plant bug 82
Fat in bread, determination of 133
Fats, analyses of cooking 206
  in nutrition, uses of 6
Feeding stuffs, report on commercial 449
Feeds, miscellaneous 462
  mixed 458, 462, 472-477
"Feinste Schlag-Sahne" 158
Fern, insects attacking 70
Fertilizers, classification of and number analyzed 374
  report on commercial 373
Fish manures 384
Flavoring extracts, tests of 143
Flea beetle 85
Flour, anaylses of 117
  beetle, confused 334, 343
    rust-red 334, 343
  moth 335
    Mediterranean 337, 344
Flours, analyses of prepared 143
Fly, lace-wing 298, 299
  syrphid 298, 299
Food, chemical composition of 4
  products, report on 101
  uses of 4
Foods, summary of examinations of 198
Forester, eight-spotted 358
Formalin fumes formula 55
  solutions, formulas for 54
Foul brood, American 441
  European 442
  treatment of 444
Four-spotted bean weevil 333
Frisbie, L. T., Co.:
  Frisbie's Acid Phosphate 14 .... 381, 382
    " " 16 .... 381, 382
    Bone Meal 388
    Conn. Special for All Crops 408
    Corn & Grain Fertilizer 408
    Dry Ground Fish 384
    Fine Bone Meal 388
    Market Garden & Top Dresser 408
    Nitrate of Soda 375
    Potato & Vegetable Grower 408
    Tankage 6-15 386
      " 9-10 386
    Tobacco Special 4 8, 41

PAGE

Frisbie, L. T., Co., *cont'd.*:—
  Frisbie's Sheep Manure 416
Fruit juices, analyses of 144
Fungicides, manufacturers of 97
  preparation of 54
Galeruca 263
Geranium, insects and fungi attacking 70
Gipsy moth 56, 234, 235, 246, 248, 359
  parasites of 249
Glomerella cingulata 242
Gluten feed 461
Gooseberry, insects and fungi attacking 70
Gracilaria elotella 364
Grain beetle 331
  saw-toothed 334, 341, 344
  moth 337, 344
    Angoumois 337, 344
    European 338, 344
Granary weevil 335, 344
Grape berry moth 71
  insects and fungi attacking 71
  leaf-hopper 71
  root worm 71
Grass, insects attacking 72
Grasshoppers 358, 364
Green apple aphis 57, 259
Grisin 157
Ground beetle 323
Grub, white 72
Halisidota caryae 325, 358
  maculata 325, 326
  tessellaris 325, 326, 358
Ham beetle, red-legged 339, 344
Hamburg steak 145
Hammond's Tonic tablets 170
Harrisina americana 361
Hay from salt marshes and river meadows, potash in 49
Headache tablets 170
Heliophila unipuncta 359, 360
Hellebore spray formula 53
Hemerocampa leucostigma 326, 357
Hemiteles utilis 283
Hessian fly 95
Heterocordylus malinus 259
Heteropelma datanae 329
Hexamethylene Tetramine tablets 173
Hickory bark beetle 72

PAGE

Hickory borer ... 73
insects attacking ... 72
tussock moth ... 72, 325, 358
Hippodamia convergens ... 298, 299
glacialis ... 298
parenthesis ... 298
xiii-punctata ... 298
Hives for bees ... 427, 429
Hollyhock, rust of ... 73
Hominy feed ... 457, 470, 471
Honey, care of extracted ... 438
comb ... 436
extracted ... 437
plants ... 439
uses of ... 439
Hop, insects and fungi attacking ... 73
Hops, spent ... 421
Horse, dairy and stock feeds ... 458, 472–477
Horse chestnut, insects and fungi attacking ... 73
radish, insect attacking ... 74
Household wastes ... 417
Humus ... 420
Hydrocyanic acid gas formula ... 54
Hydrogenation of oils ... 202
Hyphantria budea ... 322
cunea ... 319, 358
punctatissima ... 319, 322
textor ... 319, 320
Hypophosphites Compound tablets ... 174
Indian meal moth ... 335, 344
Infant foods ... 146
Insecticides, manufacturers of ... 97
preparation of ... 53
Inspection, apiaries ... 235, 242
imported nursery stock ... 240
nurseries ... 236
summary of ... 232
of feeding stuffs ... 449
International Agricultural Corporation:
Buffalo Dry Ground Fish ... 384
Economy ... 396
Farmers Choice ... 408
General Favorite ... 396
H. G. Manure ... 398
New England Special ... 408
Potash Special ... 398
Potato & Corn ... 398

PAGE

International Agricultural Corporation, *cont'd:*—
Buffalo Standard 408
Tobacco Grower 408
Top Dresser 387, 408
Vegetable & Potato 387, 408
Iodized Calcium tablets 174
Iris, insect and fungi attacking 74
Isaria farinosa 250
Itycorsia 360
Ivy, fungi attacking 74
James, Ernest L.:
James' Ground Bone 373
Janus abbreviatus 359
Jelly and junket powders 148
Joynt, John:
Wood Ashes 417, 418
Juniper web-worm 237
Kale, insects and fungi attacking 74
Kelp 422
Kerosene emulsion formula 53
Kirke Chemical Co., Inc.:
Kirke Fertilizer 398
Kremette Ice Cream Dressing 158
Lace-wing fly 298, 299
Lackey moth, European 241, 362
Lady beetle 298
convergent 298
glacial 298
nine-spotted 298
parentheses 298
red 298
spotted 298
thirteen-spotted 298
two-spotted 298
Laemophlaeus pusillus 335
LaGrippe Saratoga tablets 174
Larch, insects attacking 74
Larder beetle 339, 344
Lasioderma serricorne 339
Laspeyresia molesta 315, 359
Lead arsenate spray formula 53
Leaf beetle, elm 69, 357, 362
blight 65, 83
of iris 74
mangel 75
quince 87
blister mite 82, 237

PAGE
Leaf blotch of rose........ 88
curl of peach........ 80
hoppers........ 57, 71, 237
miner........ 62, 63, 242
peach........ 237
roller........ 56, 359, 360, 364
oak........ 237
spot........ 63, 64, 65
of ivy........ 74
strawberry........ 92
tomato........ 93
Lecanium........ 237
Leopard moth........ 69
Lesser apple worm........ 56
Lettuce, insects and fungi attacking........ 74
Leucophaea surinamensis........ 302, 306
Lilac borer........ 75, 237
insects and fungi attacking........ 75
Lily, insects attacking........ 75
Limestone, ground........ 419
Lime-sulphur solutions, formulas for........ 53, 54
Limneria pallipes........ 323
Lina japonica........ 237
scripta........ 237
Linden borer........ 75, 237
insects attacking........ 75
Linseed meal........ 454, 466, 467
Listers Agricultural Chemical Works:
Listers Ammoniated Dissolved Superphosphate, 1916.. 398
Atlas Brand Fertilizer, 1916........ 408
Bone Meal, 1916........ 388
Buyer's Choice Acid Phosphate........ 373
Celebrated Ground Bone & Tankage Acidulated. 386
Tobacco Fertilizer........ 374
" " without Potash... 408
Complete Tobacco Fertilizer without Potash.... 408
Manure, 1916........ 398
Corn & Potato Fertilizer, 1916........ 398
Plant Food, 1916........ 408
Potato Manure, 1916........ 398
Special Tobacco Fertilizer, 1916........ 398
Standard Pure Superphosphate of Lime, 1916... 398
Success Fertilizer, 1916........ 398
Superior Ammoniated Superphosphate, 1916.... 408
Valley Brand Fertilizer, 1916........ 373
Locust, insects attacking........ 75
Lophyrus similis........ 273, 288

PAGE

Lowell Fertilizer Co.:
Lowell Animal Brand ... 408
Bone Fertilizer ... 408
Empress Brand ... 408
Ground Bone ... 388
Market Garden, Special Grass & Lawn Dressing ... 408
Potato, Corn & Vegetable ... 408
Potato Manure ... 408
Phosphate ... 408
Superior Fertilizer ... 398
Tobacco Grower ... 408
Lye used for cleaning type ... 422
Lygidea mendax ... 259, 356
Lygocerus ... 299
Macrosiphum solanifolii ... 290, 357
Macrosporium ... 241
Maggot ... 261
apple ... 57, 358
cabbage root ... 63, 357
onion ... 78
Malacosoma americana ... 252, 357, 363
neustria ... 241, 242, 362
Malt extracts for bread baking, analyses of ... 114
flours for bread baking, analyses of ... 114
Malted foods ... 21
Manchester, E., & Sons:
Acid Phosphate, 14% ... 374
16% ... 381, 382
Fine Ground Bone ... 374
Ground Tankage, 60-3 ... 386
9-20 ... 374
Manchester's 1917 Formula ... 408
Special ... 398
Mangel, fungi attacking ... 75
Mantis, praying ... 323
Manure, potash in farm ... 52
Mapes F. & P. G. Co.:
Mapes Corn Manure ... 398
5 Per Cent. Ammonia Special ... 390, 408
General Special 1916 Brand ... 398
1917 Special ... 408
Potato Manure (1916 Brand) ... 398
Tobacco Manure " " ... 398
Starter, Improved ... 398
Top Dresser Full Strength (1916 Brand) ... 398
Half " " " ... 398
Maple, insects and fungi attacking ... 75

PAGE
Marine mud 422
Marmara elotella 364
Meal moth 335
Indian 335, 344
snout moth 337, 344
worm, common 331, 343
darker 332
Mediterranean flour moth 337, 344
Megilla fuscilabris 298
maculata 298
Melon, insects and fungi attacking 77
Mercury Protoiodid tablets 175
Meteorus communis 328
hyphantriae 323
versicolor 251
Midge, wheat 95, 357, 366
Migrain tablets 172
Mildew, downy 62, 68, 72
rose 89
powdery 66, 72, 73, 79, 80, 83, 89, 92
Milk, analyses of 148
analysis of condensed skim 117
Milk-butter mixture 210
Miner, bark 363
leaf 242
peach 237
Miscible oils formula 53
Mite 339, 344
pear leaf blister 82, 237
Mixed treatment tablets 175
Molasses, fat in 460
Mold of grapes, gray 72
Monodontomerus dentipes 283, 284, 287
Monodontomerus stilillator . . . . . [illegible]
Monomorium pharaonis 234
Mosaic of cucumber 68
Mosquito law 345
work in Connecticut, 1917 . . . . . 345, 359
Moth, brown-tail 82, 234, 235, 246, 247, 350
codling 56, 261
Cynthia 362
European lackey 241, 362
flour, Mediterranean 337, 344
gipsy 56, 234, 235, 246, 248, 359
grain, Angoumois 337, 344
European 338, 344
hickory tussock 72, 325, 358

PAGE
Moth, meal, Indian ... 335, 344
snout ... 337, 344
peach ... 318
tessellated tussock ... 325, 326, 358
white-marked tussock ... 73, 237, 325, 326, 357
Muck ... 420
Mud, marine ... 422
Muriate of potash ... 383
Musselizer ... 421
"Mussel Mud" ... 421
Myalgie tablets ... 175
Myzus persicae ... 293
Naphthalene as insecticide ... 53
National Fertilizer Co.:
National Ammoniated Phosphate, 1916 ... 374
Complete Root & Grain Fertilizer, 1916 ... 398
Eureka Potato Fertilizer, 1916 ... 398
Excelsior Potato Fertilizer ... 374
Extra H. G. Manure, 1916 ... 398
Potato Fertilizer ... 387, 393, 398
H. G. Top Dressing, 1916 ... 374
without Potash ... 408
Nitrogen Phosphate Mixture No. 1 ... 408
No. 2 ... 408
No. 3 ... 408
No. 4 ... 408
No. 5 ... 408
No. 6 ... 408
Potato Phosphate, 1916 ... 398
Tobacco Special, 1916 ... 398
without Potash ... 408
Universal Phosphate, 1916 ... 398
XXX Fish & Potash, 1916 ... 398
Natural Guano Co.:
"Sheep's Head" Pulverized Sheep Manure ... 416
"Nature's Own Fertilizer" ... 421
Necrobia rufipes ... 339
Neuralgie tablets ... 176
New England Fertilizer Co.:
N. E. Corn & Grain Fertilizer ... 410
Phosphate ... 410
H. G. Potato Fertilizer ... 410
Potato Fertilizer ... 387, 410
Special Tobacco Manure ... 410
Superphosphate ... 410
Nicotine solution formula ... 53

PAGE

Nitrate Agencies Co.:
N. A. C. Brand H. G. Acid Phosphate.................. 381, 382
Nitrate of Soda....................... 375
Nitrate of soda.. 375
Nitrogen-free extract.................................. 452
Nitrogenous superphosphates............................ 386
Nurseries, firms receiving certificates................ 237
inspection of................................ 236
Nursery stock, inspection of imported.................. 240
Nut Margarine.. 209
tests of..................................... 156
Nutrients, role of..................................... 450
Nutritive ratio.. 453
Oak, insects and diseases attacking.................... 77
leaf roller.. 237
scale, pit-making.................................. 237
worm, orange-striped............................... 77
Oats as breakfast food................................. 20, 38
insects and fungi attacking........................ 77
Oberea tripunctata................................... 361
var. *myops*....................................... 361
Officers and staff of station.......................... iii
Oil cake meal.................................. 457, 470, 471
Oils and fats used as foods............................ 201
Olds & Whipple:
O. & W. Castor Pomace.............................. 379
Complete Corn, Potato & Onion Fertilizer..... 398
Tobacco Fertilizer, 1% Potash...... 398
2% " 400
Dry Ground Fish.......................... 384
Fish & Potash............................ 400
H. G. Tobacco Starter.................... 410
Precipitated Bone Phosphate.............. 380
Special Grass Fertilizer................. 410
Phosphate......................... 410
Tobacco Special.......................... 410
Oleomargarine.. 208
Olethreutes hemidesma............................ 359, 364
Olive oil, summary of examinations of.................. 205
Onion, insects and fungi attacking..................... 78
Orange rust.. 63
Ovaltine... 154
Oyster Broth Powder.................................... 156
Oystero.. 156
Oyster-shell scale........................... 58, 237, 242
Pachyneuron.. 283
aphidivorum.......................... 299

PAGE

Palmer worm ... 56
Palms, scale on ... 79
Panchlora celebesa ... 306
occipitalis ... 306
submarginata ... 306
surinamensis ... 306
Paris green spray formula ... 53
Parmenter & Polsey Fertilizer Co.:
P&P Grain Grower ... 410
Plymouth Rock Brand ... 410
Potato Fertilizer ... 410
Special Tobacco Grower ... 410
Star Brand Superphosphate ... 410
Parsley, insects and fungi attacking ... 79
Parsnip, insects and fungi attacking ... 79
Pea, insects and fungi attacking ... 79
weevil ... 79, 332, 343, 344
Peach aphid ... 80, 293
borer ... 80, 358
insects and fungi attacking ... 80
leaf miner ... 237
moth ... 318, 359
orchards, general treatment of ... 81
sawfly ... 80
scale, West Indian ... 237
twig-borer ... 318
Peanut butter, analysis of ... 196
Pear borer, sinuate ... 361
insects and fungi attacking ... 82
leaf blister mite ... 82, 237
psylla ... 82
Peat ... 420
Periplaneta australasiae ... 304
Pernoplasmopara cubensis ... 264
Pestalozzia guepini ... 242
Pharaoh's ant ... 234, 235, 314
Phenolphthalein tablets ... 176
Philosamia cynthia ... 362
Phlox, insect and fungous attacking ... 83
Phoma rot of turnip ... 94
Phospho Plaster ... 383
Phyllosticta ... 242
Phylloxera of grape ... 71
Pine blister rust, white ... 84, 236
insects and fungi attacking ... 83
leaf scale ... 83, 237
sawfly, European or imported ... 234, 235, 237, 273

PAGE
Pine weevil........ 83, 365
Piophila casei........ 339
Pissodes approximatus........ 365
Pit-making oak scale........ 237
Plochionis timidus........ 323
Plodia interpunctella........ 335
Plum, insects and fungi attacking........ 84
Podisus maculiventris........ 323
Point rot of tomato........ 93
Poisoned bran mash formula........ 53
Poisons, examination of samples suspected of containing........ 197
Pontia rapae........ 358
Poplar canker........ 237
insects and fungi attacking........ 85
Potash, domestic supplies of........ 47
in farm manure........ 52
muriate of........ 383
Potassium sulphide solution formula........ 55
Potato aphid........ 85, 236, 290, 357
beetle, three-lined........ 85
insects and fungi attacking........ 85
Poultry, expense and income account of........ 220
feeds........ 460, 462, 476, 477
in the city, an experience in keeping........ 217
Powdery mildew of chrysanthemum........ 66
grapes........ 72
pea........ 79
peach........ 80
phlox........ 83
rye........ 89
strawberry........ 92
Precipitated bone phosphate........ 380
phosphate........ 381
Prionidus cristatus........ 323
Privet, insects and fungi attacking........ 86
Proprietary mixed feeds........ 458, 462, 472–477
Protein of feeding stuffs........ 451
Proteins, definition of........ 4
in nutrition, special uses of........ 5
Pseudomonas tumifaciens........ 241
Psocids........ 361
Pterodela pedicularis........ 361
Pteromalus........ 283
boucheanus........ 323
Pulverized Manure Co.:
Wizard Brand Manure........ 416
Pumpkin, insects and fungi attacking........ 90

PAGE
Pycnoscelus obscurus 306
surinamensis 234, 302
Pyralis farinalis 337
Quince, insects and fungi attacking 87
Quinin and Nux Vomica tablets 177
Sulphate tablets 177
Radish, insects and fungi attacking 87
Railroad worm 57
Raspberry, insects and fungi attacking 87
Red-bug, false apple 234, 259, 356
true 259
Red bugs 57
spider 57
Red-humped caterpillar 57, 237, 329, 358
Red-necked cane borer 62
Report of board of control v
entomologist 231
treasurer xiv
on commercial feeding stuffs 449
fertilizers 373
drug products 101, 161
food products 101
Rhagoletis pomonella 358
Rhododendron, insects and fungi attacking 88
Rice products as breakfast food 21, 39
weevil 335, 344
Rogers & Hubbard Co.:
Hubbard's "B. B." Oats & Top Dressing 410
Soluble Corn & General Crops 410
Potato Manure 387, 400
Tobacco Manure 410, 414
Pure Raw Knuckle Bone Flour 388
Strictly Pure Fine Bone 388
Tobacco Special 400
Rogers' All Soils—All Crops Phosphate 410
Climax Tobacco Brand 410
Complete Phosphate 410
H. G. Oats & Top Dressing 410
Soluble Corn & Onion Manure 410
Tobacco & Potato Manure 400
Manure 393, 410
Tobacco Grower (vegetable formula) 400, 402
Potato Phosphate 410
Pure Fine Ground Bone 388
Knuckle Bone Flour 386, 388
R. & H.'s All Soils—All Crops Phosphate 410, 414
Complete Phosphate 410

PAGE
Rogers & Hubbard Co., *cont'd:*—
R. & H.'s Potato Phosphate.......................... 410
Valley Tobacco Brand.................... 410
Root maggot, cabbage 63, 357
rot of tobacco.. 93
Rose chafer...71, 88, 357
insects and fungi attacking.......................... 88
scale.. 237
slug... 88
Rosy apple aphis.....................................57, 259, 356
Round-headed borer..................................... 57
Royster, F. S., Guano Co.:
Dry Ground Fish.................................. 384
Nitrate of Soda.................................. 375
Royster's Arrow Head Tobacco Fertilizer............. 400
Curfew Ammoniated Superphosphate......... 393, 410
Dreadnaught Fertilizer..................390, 393, 400
Drillwell Phosphate...................... 400
Fine Ground Bone Meal.................. 388
Goodwill Ammoniated Superphosphate....... 393, 410
H. G. 16% Acid Phosphate................ 382
Innovation Ammoniated Superphosphate..... 410
Logical Compound....................... 390, 400
Penguin Ammoniated Superphosphate........ 410
Pipe of Peace Tobacco Fertilizer............ 400
Sensation Fertilizer........................ 400
Truckers' Delight.......................... 400
True Blue Compound...................... 400
Valley Tobacco Compound................. 410, 414
Stevens' Formula................................. 410
Rust, cedar-apple...................................... 65
Rust of apples... 58
carnations.. 64
chrysanthemums.................................... 67
oats, black stem.................................. 78
quince.. 87
snapdragon.. 90
orange.. 63
white pine blister................................ 84, 236
Rust-red flour beetle................................ 334, 343
Rusts of wheat... 95
on willow.. 96
Rye, insects and fungi attacking....................... 89
products.......................................456, 470, 471
Ryzon, analysis of..................................... 157
Salad oils... 204
Salsify, soft rot of.................................... 89

PAGE

Sanderson Fertilizer & Chemical Co.:
Ground Tankage 6-30 386
" " 9-20 386
Kelsey's Bone, Fish & Potash, 1916 .... 400, 402
Nitrate of Soda 375
Sanderson's Acid Phosphate 382
Atlantic Coast Bone, Fish & Potash, 1916 400
Complete Tobacco Grower, 1916 400
Corn Superphosphate, 1916 400
Fine Ground Bone 386, 388
Formula A, 1916 400
B, 1916 400
H. G. Ammoniated Phosphate 393, 412, 414
Phosphate without Potash 412
Potato Manure, 1916 400
Special without Potash 412
Top Dressing for Grass & Grain, 1916 .... 400, 414
San José scale 57, 80, 237
Sausage, tests of 150
Sawfly, Abbott's 237
blackberry 63
European pine 234, 235, 237, 273
peach 80
raspberry 87
Saw-toothed grain beetle 334, 341, 344
Scab of apples 58
peach 81
pear 82
potato 86
powdery 86
tomato 93
Scale, cottony maple 76
elm 70, 237
oak, pit-making 237
on palms 79
oyster-shell 58, 237, 242
peach, West Indian 237
pine leaf 83, 237
rose 88, 237
San José 57, 80, 237
scurfy 68, 237
terrapin 76
tulip tree 94, 237
woolly maple leaf 76
Schedius kuvanae 250
Schizura concinna 329, 358
Scurfy scale 68, 237

PAGE
Sea weeds, ashes of.. 52
Semolina.. 196
Shay, C. M., Co.:
Shay's Formula 4-10.. 412, 414
Sheep manure.. 416, 422
Shoemaker, M. L., Co.:
Swift-Sure Bone Meal.. 388
Superphosphate for Tobacco & General Use.. 412
Shot-hole borer.. 237
of peach.. 80
Silvanus surinamensis.. 334
Sitodrepa panicea.. 334
Sitotroga cerealella.. 337
Skipper, cheese.. 339, 344
Smoke-house, analyses of ashes from.. 52
Smokers for beekeepers.. 431
Smut of oats.. 78
onion.. 78
Smuts of wheat.. 95
Snapdragon, insects and fungi attacking.. 89
Soap solution as insecticide, formula for.. 53
Sodium Bromid tablets.. 178
Salicylate tablets.. 178
Soft rot of iris.. 74
turnip.. 94
Soldier bugs.. 323
Solution Iodin and Potassium Iodid.. 181
Soot.. 422
Sooty blotch.. 59
Sowbugs.. 312
Soy bean, bacterial leaf spot of.. 90
fungi attacking.. 90
Spencer Brothers, Inc.:
Castor Meal Pomace.. 379
Sphaerophoria cylindrica.. 299
Spices, tests of.. 150
Spider, red.. 83
Spinach aphid.. 293
Spirit of Ammonia, Aromatic.. 181
Split peas, analysis of.. 157
Spot disease of violet.. 94
Spray injury.. 59
Spraying machinery, manufacturers of.. 97
supplies, Connecticut dealers in.. 98
Springfield Rendering Co.:
Springfield Animal Fertilizer.. 412
Spruce gall aphid.. 90, 237

PAGE

Spruce, insects attacking 90
Squash bugs 91, 357
    insects and fungi attacking 90
    lady beetle 90
Squash-vine borer 91
Staff, members of station iii
Stagmomantis carolina 323
Stalk borer of dahlia 69
Starfish, ground 421
Stem rot 64
    of onion 79
Stinking smut 95
Stocking hives with bees 432
Strawberry, insects and fungi attacking 91
Striped cucumber beetle 90, 234, 262, 357
Strontium Salicylate tablets 178
Strychnin Sulphate tablets 179
Sugar, tests of 154
Sulphur mixture formula 55
Superphosphates, analyses of nitrogenous 394-415
    brands requiring special notice 392
    nitrogenous 386
        guaranties 386
        prices of 391
        quality of plant food in 388
Supers for bee hives 428
Swarming of bees, control of 435
Syntomosphyrum esurus 323
Syrphid fly 298, 299
Syrphus americana 299
Syrup Hydriodic Acid 181
Table of Contents iv
Tablets, examination of medicated 161
    variations in medicament in 185
        weight of medicinal 182
Tachina 323
Tankage 385
Tapioca, analysis of 155
Tarnished plant bug 57
Telenomus bifidus 323
Temperance beverages, determination of alcohol in 152
Tenebrio molitor 331
    obscurus 332
Tenebrioides mauritanicus 332
Tent caterpillar 56, 252, 357, 358, 362, 363
Tessellated tussock moth 325, 326, 358
Thrips on onion 78

PAGE
Thrips on pear ... 82
Tinea granella ... 338
Tip burn of potato ... 86
Tobacco dust, nicotine in ... 196
insects and fungi attacking ... 92
wastes ... 421
worm ... 92
Toilet preparations, tests of ... 191
Tomato, insects and fungi attacking ... 93
Treasurer, report of ... xiv
Tribolium confusum ... 334
ferrugineum ... 334
Troctes divinatorius ... 339
Trogoderma tarsale ... 338
Tulip-tree scale ... 94, 237
Turnip aphid ... 94, 358
insects and fungi attacking ... 94
Tussock moth, hickory ... 72, 325, 358
tessellated ... 325, 326, 358
white-marked ... 73, 237, 325, 326, 357
moths ... 57
Twig borers ... 360
Tyloderma foveolatum ... 361
Tyroglyphus ... 339
Vegetables, composition of dried ... 160
drying with cold blast ... 158
Vegex Cubes ... 157
Vinegar ... 154
Violet, insects and fungi attacking ... 94
Virginia-Carolina Chemical Co.:
V-C. C. Co.'s Ammoniated Bonephosphate for All Crops. 412
H. G. Acid Phosphate ... 381, 382
Corn & Vegetable Compound ... 412
Indian Brand for Tobacco No. 1 ... 400
" 2 ... 400
without Potash. 412, 414
Owl Brand Potato & Truck Fertilizer ... 400
Special Top Dresser ... 412
20th Century Potato Manure without Potash ... 412
XXXX Fish & Potash Mixture ... 400
Walnut caterpillar ... 95, 326, 358
insects attacking ... 95
Watermelon, anthracnose of ... 95
Web-worm, fall ... 82, 237, 319, 324, 325 358
juniper ... 237
Weevil, bean, common ... 61, 333, 340, 343, 344

	PAGE
Weevil, bean, four-spotted	66, 333
chestnut	66
granary	335, 344
pea	79, 332, 343, 344
pine, red	365
red	367
rice	335, 344
white pine	83
Weevils	61
West Indian peach scale	237
Wheat, insects and fungi attacking	95
midge	95, 357, 366
products	454, 461, 466–471
as breakfast food	21, 38
Wheel bug	323
White fly	93
pickle of cucumber	68
White-marked tussock moth	73, 237, 325, 326, 357
White-pine-currant blister rust	84, 236
weevil	83
Wilcox Fertilizer Co.:	
Wilcox Acid Phosphate	381, 382
Complete Bone Superphosphate	412
Corn Special	412
Fish & Potash	400
Grass Fertilizer	412
H. G. Tankage	386
Vegetable Fertilizer	400
Nitrate of Soda	375
Potato Fertilizer	402
Onion & Vegetable Phosphate	402
Pure Ground Bone	388
Tobacco Special	402
Willow, insects and fungi attacking	96
Wilt of melon	77
raspberry	88
squash	91
tomato	94
Winter injury	59, 81
Wireworms	357
Witch hazel stills, analyses of ashes from	51
Witherbee, Sherman & Co.:	
Barium-Phosphate	383
Wood alcohol in toilet preparations	193
ashes	417
Woodruff, S. D., & Sons:	
Woodruff's Home Mixture	402
Woolly aphis	57, 70, 242
Worcester Rendering Co.:	
Royal Worcester Corn & Grain Fertilizer	412
Potato & Vegetable Fertilizer	412
Workers (bee)	434
Yeast, analysis of	117
Food, analysis of Arkady	117
foods, chemical analyses and baking tests with	113
Yellow-necked caterpillar	57, 328, 358
Yellows of asters	61
peach	81
raspberry	88
[illegible]	[illegible]